# 2018

# Contents

We present our Annual Report in two parts. Part 1 provides an overview of Manaaki Whenua, highlights of our science that show the contribution we are making towards our four ambitions for New Zealand, and an update on the progress we are making in delivering on Strategy 22, our 5-year strategy. In Part 2 we present our directors' report and financial statements.

PDF versions of both Part 1 and Part 2 are available for download from the Manaaki Whenua – Landcare Research website: manaakiwhenua.co.nz/report

*A flowering Mānuka branch near Nelson Lakes.*

## PART 1

# Our Land, Our Future

# About us

As the Crown Research Institute for our land environment, biosecurity and biodiversity, our role and responsibility are clear: Our Land, Our Future. This land, and everything that shares it with us, is our future.

Our role is to ensure that all New Zealanders have the knowledge, understanding and tools to truly live in harmony with our land: enjoying its many gifts, preserving its unique diversity, and enriching it through our creativity, care, industry, and culture.

*Palaeoecologists Dr Jamie Wood and Dr Michelle McKeown hike down the Kepler Track in Te Anau, Southland.*

# A word from Jane and Richard

We are very pleased to welcome you to our report on what has been an exceptional year for Manaaki Whenua. Across the organisation our 360 staff have brought their expertise, passion, and hard work to bear on the ambitions we seek for New Zealanders. The volume of our work was at a record level, with science revenue of $67 million 18% higher than in the previous year and 30% higher than 2 years ago. Our staff have continued to be recognised nationally and internationally for the quality of their work.

Our Enviro-Mark Solutions subsidiary also had a record year: it attracted many new customers to its carbon management programmes, and its revenue of $3.4 million was up 18% on the previous year. The New Zealand's Biological Heritage National Science Challenge, which we host, again achieved a gold rating from MBIE for its performance.

We especially want to thank our staff, who have shown their dedication to making a difference for New Zealand through the quality of their work and interactions with our partners. We thank our GM People & Culture, Katrina Benedetti, and Board Director, Dr Chris Down, who left us at the end of the year, and our GM Science Partnerships, Justine Daw, who will leave in September, in each case after many years of valuable contributions to Manaaki Whenua.

We also wish to thank our partners in central and local government, Māori organisations, the primary sector, businesses, science organisations around the world, and groups within the New Zealand and Pacific communities. Our excellent relationships working closely with you have enabled us to develop valuable research and science programmes and deliver high-quality science outcomes for your use.

Our purpose is science for our land and future, because our land is the future of our national identity, our economy, and our well-being. We aim to ensure that all New Zealanders have the knowledge, tools, and understanding to live in harmony with the land and sustain its biological diversity. In this report we tell the stories of several research and science areas that are good examples of our contribution to those initiatives and partners. From analysis of ancient DNA that informs conservation planning to measuring the ecological and environmental impacts of major wilding conifer pine species, this work and its impacts are Manaaki Whenua's contribution to sustainable development in New Zealand, in the Pacific, and in other countries where our scientists are working.

During the year the new government in New Zealand introduced policies with which our strategy, research, and science are well aligned. These include policies on freshwater quality, a low-carbon economy, protection of our native biodiversity, growing regional prosperity, and managing environmental risks – including climate change. We have also seen the beginnings of a sea-change in action by private sector businesses across the board, including businesses in the primary sector, on issues relating to the natural environment and climate change.

This follows moves by government, consumer demands and significant action by other leading New Zealand businesses in recent years.

Māori organisations are increasingly seeking support from science to integrate cultural values and traditional knowledge (mātauranga Māori) to develop Māori-owned natural resources. Examples are new land use concepts and natural products developed from native species. Community groups are tackling a wide range of environmental challenges and are increasingly involved in citizen science projects with us, such as the New Zealand Garden Bird Survey.

Manaaki Whenua also contributes to sustainable development through our people and relationships in local communities. We grew our capacity significantly.

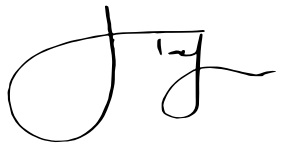
Our 53 new recruits during the year came from 12 different countries (53% from New Zealand) as we seek the best talent and fit with our organisation. Each year we support around 50 graduate students at New Zealand universities to help build the skills of tomorrow. Forty-six percent of our people are women, and we have striven to ensure pay equity, with the value of work at Manaaki Whenua being assessed in terms of skills, knowledge and responsibility. We also have employment equity, with everyone having the same opportunities to participate fully in employment. We invest in our people's skills and in science links to leading organisations around the world.

We are implementing our 5-year strategy (Strategy 22), which aims to increase the innovation, value, integration and accessibility of our science and its engagement with mātauranga Māori. In particular, we are working to enhance

staff well-being in addition to health and safety, especially in this growth phase of the business, which is putting extra pressure on our people. We take the health, safety, and well-being of our people very seriously, and are working to understand the challenges of the competing pressures and constraints on our people so that we can continuously improve our performance. We acknowledge with gratitude the work of our leaders and our Vox Group, which has facilitated valuable internal conversations.

We have embarked on a major building project at our Lincoln headquarters and are working with staff there on new ways of working that will enhance team performance, collaboration and integration. We have continued to work on achieving a clear line of sight from national ambitions and impacts, through the outcomes of our science, to the science that is actually done by our people. This alignment is reflected in this report.

While the prospects for the global natural environment are increasingly challenging, we have strong prospects for our work and ability to contribute solutions. Together with our valued family members – our Enviro-Mark Solutions business and New Zealand's Biological Heritage National Science Challenge, both of which have achieved great successes during the year – we will continue to work with our partners to achieve important outcomes for society and the environment.



Jane Taylor – Chair

28 August 2018

Richard Gordon – CEO

28 August 2018

# He kupu whakataki mai i Jane rāua ko Richard

Harakoakoa ana mātou kia whakatakotohia te Pūrongo ā Tau mō Manaaki Whenua. He tau inati tēnei tau kua hipa. Puta noa i te tōpūtanga, 360 ngā kaimahi kua whakarīrā, kua tukuna mai o rātou pūkenga kia whakatutukingia ngā āwhero e wawatangia nei mō Aotearoa. Inā kē noa atu te rahinga o te mahi. Ko te moni ā-tau mō te pūtaiao, he $67 miriona. He 18 ōrau te pikinga ake mai i tērā tau, ā, he 30 ōrau te pikinga mai i te tau i mua atu o tērā. Heoi, kua rangona whānuitia ngā kaimahi ki tēnei whenua, ki rāwāhi hoki, mō te kounga o te mahi kua oti nei i a rātou. Ka mutu, he tau tino pai rawa atu hoki mō Te Rōpū Whakataunga Tohu Taiao.  E hia kē ngā kiritaki hou kua uru mai ki te whakatakanga whakahaere hauhā. Waihoki he $3.4 miriona te moni ā-tau, he 18 ōrau te pikinga ake mai i te tau kua hori.

Rere kau ana ngā mihi ki ō mātou kaimahi, mō rātou i ngākau titikaha kia whaihua mō Aotearoa whānui nā te kounga o ā rātou mahi, pāhekotanga hoki ki ō mātou hoa haere kōtui. Ka tika me mihi hoki ki a Katrina Benedetti (Kaiwhakahaere Matua: Tāngata me te Ahurea) me tō mātou Mema Poari, Tākuta Chris Downs. Kua wehe atu rāua tahi, engari e hia kē nei ngā tau i whakapau kaha ai rāua hei āwhina i te kaupapa.

Me mihi ki ō mātou hoa haere kōtui kei roto i te Kāwanatanga ā Rohe, Kāwanatanga Pūtahi hoki, ngā rōpū Māori, te rāngai ahumahi matua, ngā rōpū pakihi, pūtaiao hoki puta noa me ngā rōpū mai i ngā hāpori nō Aotearoa me Te Moana nui ā Kiwa. Nā te mahi tahi me rātou i taea ai te whakawhanake whakatakanga pūtaiao, rangahau whaipainga hoki. I taea hoki e mātou te whakarato putanga whaikounga hei whakamahi mā koutou.

Ko tō mātou koronga, ko te pūtaiao mō tō tātou whenua, mō ngā rā kei mua, nā te mea ko tō tātou whenua he taonga tuku iho: koia hoki te pūtake o te tuakiri ā-whenua nei, te ōhanga me te oranga hoki o te tangata. Ko te tino whāinga, kia whakatūturungia kia whiwhi ngā kiriirarau katoa o Aotearoa ki ngā mātauranga, ngā taputapu me te māramatanga kia noho mauri tau ai ki runga i te whenua, kia toitū hoki ngā koiora kanorau. Kei roto i tēnei pūrongo ētahi pakiwaitara rangahau, pūtaiao hoki. Hei tauira: ko te tātari pītau ira nō tūāuriuri hei āwhina i te whakatakoto mahere tiaki taiao. Tērā anō he tauira - ko te ine whakaawetanga, ā-taiao, ā-pūnaha hauropi hoki, o ngā rākau paina tūwā.

Ko ēnei mahi me ōna tukunga iho ka tū hei tāpaetanga a Manaaki Whenua ki tēnei mea te whanaketanga tauwhiro ki Aotearoa, ki rāwāhi hoki, ā, ki ngā wāhi katoa e mahi nei ō mātou kaipūtaiao.

I tēnei tau kua hipa i whakaurungia e te Kāwanatanga hou ētahi kaupapa here mō te taiao. Ko ēnei kaupapa e hāngai pū ana ki te rautaki, ki ngā rangahau me te pūtaiao hoki a Manaaki Whenua: pērā ki te kounga o te wai Māori, te ōhanga whakamimiti hauhā, te tiaki i te kanorau o ngā koiora taketake, te whakatipu i te tōnuitanga o ngā rohe me te whakahaere tūraru taiao, tae noa ki te whakamahanatanga o te āhuarangi. E kite hoki nei tātou i te tīmatanga o tētahi huringa ā-tai i roto i ngā pākihi puta noa i te rāngai tūmataiti, me te rāngai ahumahi matua hoki, e pā ana ki ngā kaupapa taiao, whakamahana āhuarangi hoki. Kua pēnei whai muri i ētahi mahi a te Kāwanatanga me ngā hiahia o te kiritaki, tae noa ki ētahi mahi whakahirahira mai i ētahi pākihi mātāmua ki Aotearoa i ngā tau tata kua hipa.

Kei te nui haere hoki  te kimi tautoko a ngā rōpū Māori mai i te ao pūtaiao hei pāhekoheko ki o rātou ake mātauranga, mātāpono hoki i a rātou e whakawhanake ana i o rātou ake rauemi taiao. Hei tauira ēnei: (1) ko ētahi tirohanga hou hei whakawhanake whenua, (2) ko ngā hua me ngā rongoā mai i ngā koiora taketake.

Ko ngā rōpū hāpori kei te tuki atu ki ētahi momo wero ā-taiao whānui rawa. Kei te hono mai hoki ēnei rōpū ki a Manaaki Whenua i runga i ētahi whakatakanga “Pūtaiao Kiriirarau” pērā ki te Rangahau Manu Māra.

Ka whaiwāhi hoki a Manaaki Whenua ki te whanaketanga tauwhiro mō ō mātou tāngata, hononga hoki i roto i ngā hāpori ā-rohe nei. I hira tā mātou whakatipu āheitanga. 53 ngā kaimahi hou i tīmata i te tau kua hipa, mai i ngā whenua 12 (53 ōrau mai Aotearoa). Kei te kimi mātou i ngā pūkenga tino pai rawa atu mō tō mātou tōpūtanga, i ngā tāngata tino hāngai nei ki ō mātou mātāpono. Ia tau ka tautokona ngā tauira 50 kua whakapōtaehia kei ngā whare wānanga o Aotearoa hei āwhina i a rātou kia hangaia ngā pūkenga e hiahiatia nei mō āpōpō. 45 ōrau o ō mātou kaimahi he wahine, ā, e ngana ana mātou kia ōrite te utu e whiwhi nei rātou ahakoa wahine mai, tāne mai. Arā ka utua te tangata i runga anō i ōna pūkenga, ōna mātauranga me ōna kawenga.  Whakangao ai mātou ki ngā pūkenga a te

tangata, ki ngā hononga pūtaiao hoki ki ngā rōpū mātāmua puta noa i te ao.

Kei te whakatinanahia tā mātou rautaki rima tau (Rautaki 22). Ko tōna whāinga, he whakapiki i te auahatanga, te hua, te pāhekohekotanga, te tomonga ki tō mātou pūtaiao me tōna hononga ki te mātauranga Māori. E whakapau kaha ana mātou kia whakapikingia te oranga o ngā kaimahi i te wā tonu nei kei te piki haere hoki te rahinga o te mahi. He take whakahirahira rawa te oranga me te haumarutanga o ō mātou tāngata.  E mahi ana kia mārama pai mātou ki ngā wero e pā ana ki te mahi me ngā taupatupatu, pēhanga, kōpiri hoki.  Hei aha? Hei whakapai tonu i aua raru i ngā wā katoa. E mihi manawareka ana ki ō  mātou kaiārahi me te VoxGroup hoki mō ngā mahi kua oti i a rātou. I whakarite kōrero hoki rātou i waenga i a mātou anō, ā, ka whaihua hoki ēnei kōrero.

Kua tīmatahia he whakatakanga hanga whare hou hoki ki te tari matua ki Ōtautahi . E kōrero ana mātou ki ngā kaimahi o reira kia whakamātauria ētahi āhuatanga mahi hou. Ko te tūmanako, mā ēnei āhuatanga hou e kaha ake ai te mahi, te mahitahi me te pāhekoheko hoki.

E mahi tonu ana mātou kia tīaroaro ngā hononga mai i ngā āwhero ā-motu, ngā whakaawetanga  me ngā tukunga iho hoki ki te momo pūtaiao e mahi kē nei mātou. Kua whakaaturia tēnei tīaroarotanga i roto i te pūrongo nei.

Heoi, kei te piki haere ngā wero mō te aotūroa. Ahakoa tēnā kei te tū kaha a Manaaki Whenua hei tuku whakataunga ki ētahi o aua wero. Arā o mātou whanaunga – ko Te Rōpū Whakataunga Tohu Taiao, ko Te Wero Pūtaiao ā-Motu nei mō Ngā Koiora Tuku Iho. Kua tino angitū rāua tahi i te tau kua hipa. Ka mahi tahi tonu mātou ko ō mātou hoa haere kōtui hei whakatutuki tukunga iho whakahirahira rawa mō te hapori whānui me te taiao hoki.

Jane Taylor – Toihau
28 Hereturikōkā 2018

Richard Gordon – Mana Hautū
28 Hereturikōkā 2018

Translation: Holden Hohaia


*Jenny Wilson, te kaiwhiwhi o te Karahipi o Tākuta Maggie Lawton, rāua ko Ella Lawton, te tamāhine a Tākuta Lawton (kua moe mai rā ia).*

# Our commitment to the UN Sustainable Development Goals

**As the Crown Research Institute for our biodiversity, biosecurity and land environment, Manaaki Whenua directly contributes to the United Nations Sustainable Development Goals (SDGs).**

The 17 SDGs represent an ecosystem view of a sustainable world. The interconnectedness of these goals highlights that to make progress against them requires partnership across the science system, government, communities, countries, and people. Partnership and integration as a way to create impact is an increasing focus for our projects and programmes of work.

In the following sections we will present highlights of our work focussed on our four ambitions for New Zealand: Our Biodiversity, Our Biosecurity, Our Land, and Our Environment. This work directly supports the four UN SDGs that relate to the health of our biosphere: Life on Land, Life below Water, Climate Action, and Clean Water and Sanitation.

These four SDGs underpin a wider set of societal goals, and Manaaki Whenua's science is increasingly exploring the links between the health of our environment and the health of society. As a New Zealand business, we also contribute directly to economic goals through sustainable business practices and as a good employer.

As New Zealand seeks to make progress towards the Sustainable Development Goals, we are working closely with the public sector, private sector, and civil society to understand sustainable development and implement pathways to achieve the SDGs and a sustainable economy.

## Highlights

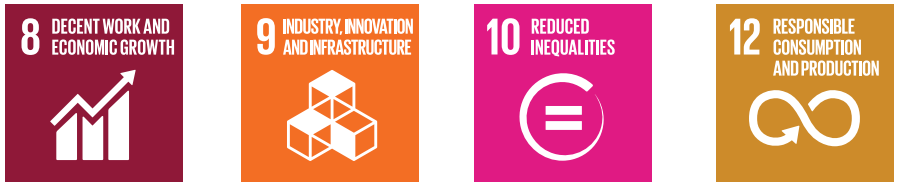
We are surveying New Zealand businesses to understand current sustainability activities, understand current actions related to the SDGs, identify opportunities for partnerships / collaborations, and identify any needs or support that businesses may need to be more sustainable.

We are leading a think piece under the Our Land and Water National Science Challenge (NSC) to see where the NSCs might be able to contribute now and in the future to New Zealand meeting its obligations under the UN Sustainable Development Goals.

The 2019 budget is known as the 'Wellbeing Budget', and we are working with Treasury to develop a new 'well-being monitor' (index) by November. The concept is to assess the contribution of each of the four capitals (natural, social, human, physical/financial) that influence well-being, and develop indicators to help track how these contributions are changing over time.

We were invited onto a national Natural Capital Accounting Working Group to support The Treasury's Living Standards Framework. This is a key opportunity to influence natural capital accounting in New Zealand by demonstrating ecosystem services approaches. Our representation on this group reflects our leadership in the international IPBES (The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services). We are discussing with Ministry for the Environment (MfE) the opportunity to use Land Cover Database (LCDB) information as a baseline to track ecosystem services changes, giving weight to the growing calls for stable funding for the LCDB.

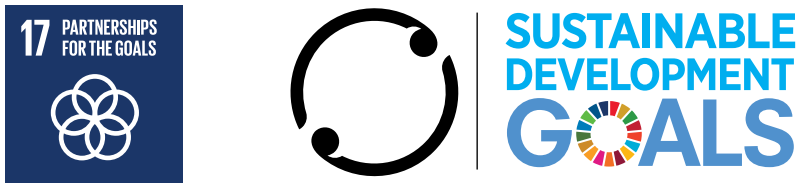
Sustainable economy




Sustainable society


Sustainable biosphere


Partnership for a sustainable world




# Science for our land and our future

Ko te pūtaiao mō tō tātou whenua, mō āpōpō

# Our Purpose

**Science for our land and our future – Ko te pūtaiao mō tō tātou whenua, mō āpōpō**

We are an organisation of 380 scientists, researchers and experts who are dedicated to helping New Zealanders understand and live well with our land. We want to ensure all New Zealanders have the knowledge, understanding, and tools to live in harmony with our land by enjoying its many gifts, preserving its unique diversity, and enriching it with our creativity, care, and culture.

Our Statement of Core Purpose (SCP) is to drive innovation in New Zealand's management of terrestrial biodiversity and land resources to protect and enhance the terrestrial environment and grow New Zealand's prosperity.
Under the Crown's SCP for Manaaki Whenua we are mandated to:

- improve the measurement, management, and protection of New Zealand's terrestrial ecosystems and biodiversity, including those in the conservation estate
- achieve the sustainable use of land resources and their ecosystem services across catchments and sectors
- improve the measurement and mitigation of greenhouse gases in the terrestrial biosphere
- increase the ability of New Zealand industries and organisations to develop within environmental limits and meet market and community requirements.

*Researcher Dr Peter Johnston from Manaaki Whenua, John Steel, Michael Pilkington, and Penelope Gillette of the University of Otago work to identify fungi specimens collected at the 32nd Fungal Foray held near Lake Brunner, West Coast, NZ*

# Our Vision

Acknowledging the unique and special relationship that Māori have with Aotearoa and with their land and the environment, we draw on a uniquely Māori perspective of the world around us. Tāne, Rongo, and Haumia-Tiketike are tamariki (children) of Rangi, our Sky Father, and Papa, our Earth Mother. Together they hold dominion over the forests and both cultivated and uncultivated food (e.g. kūmara and fernroot) and the land-based realms they exist within. If we use the land wisely, then the domains of Tāne, Rongo, and Haumia-Tiketike will be in balance.

This concept of wise land use is a core purpose of Manaaki Whenua – Landcare Research, and inherent in kaitiakitanga (custodianship) of our natural taonga and resources for future generations.

Holden Hohaia

GM Māori Partnerships

## Kia matomato te tupu a Tāne, a Rongo, a Haumia-Tiketike

Let it be that the land and all its fruits may flourish

# Our Values

Our identity is underpinned by shared values we collectively cherish in each other. Science that delivers reflects our shared purpose, and our shared commitment to doing science and research that will result in practical solutions for New Zealand.
As fascinating as any research can be, we value research relevant to New Zealand and the challenges we face as a country. Our science must be excellent, and as an independent research institute our integrity underpins our partners' trust.

'Manaaki tangata' means 'care for the people'.
Our diversity of skills, experiences, nationalities and knowledge allows us to understand and solve complex problems. By partnering with other people and organisations we can expand that diversity to great effect and still share a common purpose.
This unites our action, our resolve, and the impact we can have for New Zealand. Our success rests with our people, so we are driven to care for them and make sure they have an environment and support that allow them to succeed.

## Science that Delivers

Excellence • Relevance • Integrity

## Manaaki Tangata

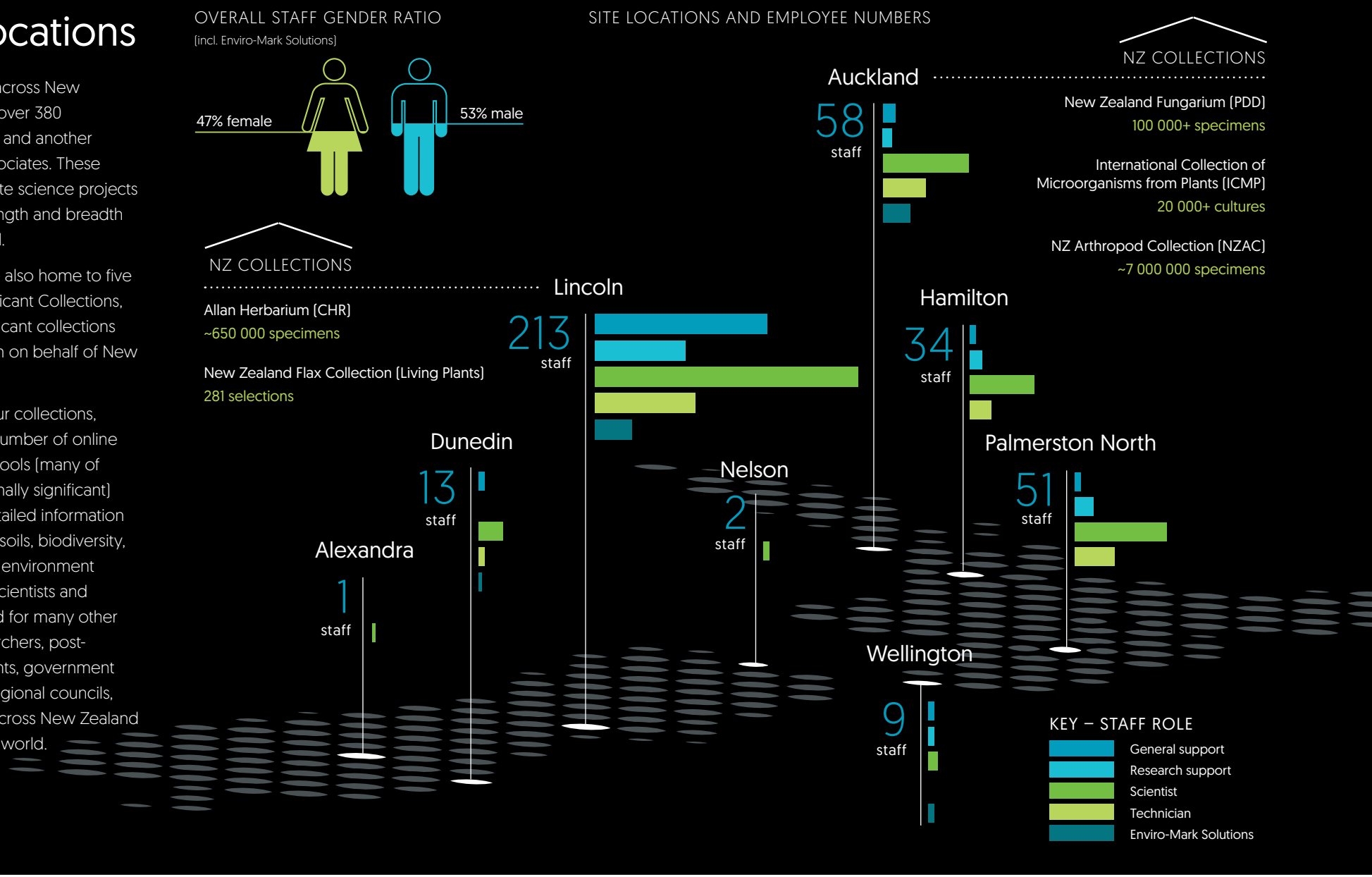
Partnering • Caring • Common purpose

# Our Locations

Our eight sites across New Zealand house over 380 permanent staff and another 60 research associates. These locations facilitate science projects that span the length and breadth of New Zealand.

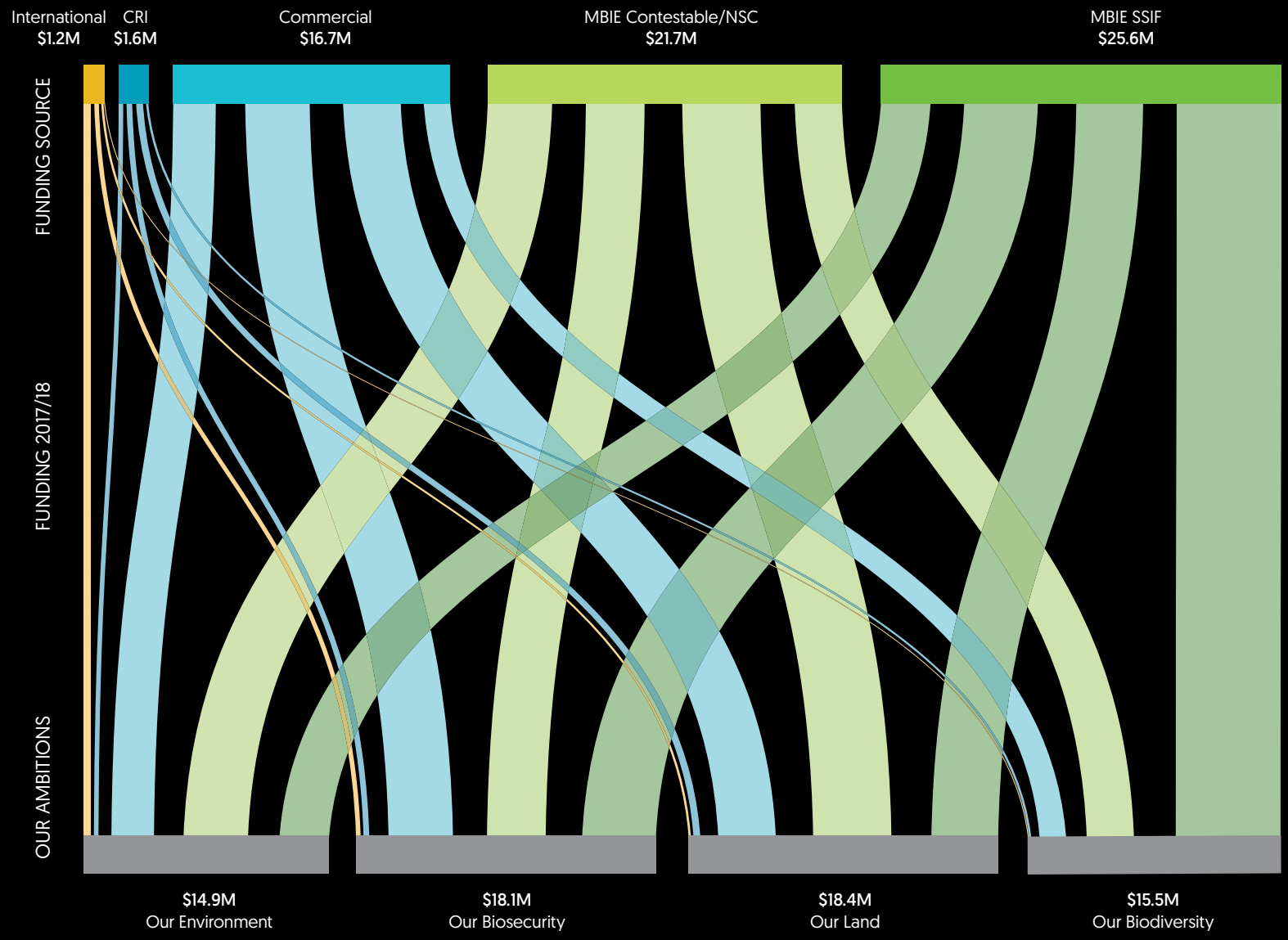
Several sites are also home to five Nationally Significant Collections, and other significant collections that we maintain on behalf of New Zealand.

In addition to our collections, we maintain a number of online databases and tools (many of which are nationally significant) that provide detailed information about our land, soils, biodiversity, biosecurity and environment for use by our scientists and researchers, and for many other scientists, researchers, post-graduate students, government departments, regional councils, and industries across New Zealand and around the world.



# Our Funding & Impacts

Our science and research are funded from a variety of sources, including the New Zealand Government, industry, and international sources. This funding powers research programmes across our four ambitions for New Zealand.



# Our Board

**Jane Taylor**
Chair
Jane is a professional director, with a strong background in both law and finance.

She holds numerous directorships and is also chair of Predator Free 2050 Ltd, a key player in achieving New Zealand's Predator Free 2050 ambition.

She was awarded the Otago Daily Times Business Leader of the Year for 2016.

**Dr Paul Reynolds QSO**
Deputy Chair
Paul served as Chief Executive of the Ministry for the Environment from 2008 until 2015. He holds a PhD in Biochemistry from the University of Otago.

**Prof. Caroline Saunders**
Director
Caroline has 30 years' research expertise and over 300 publications specialising in sustainable economic development.

**Prof. Emily Parker**
Director
Emily is a Professor in Chemistry and Biochemistry at Victoria University, leading a team exploring the understanding and application of complex biomolecules.

**Dr Chris Downs**
Director
Chris is Research Director for CSIRO's Agriculture and Food Business Unit in Australia. He leads science capability in food innovation and the delivery of science impact.

**Ngarimu Blair**
Director
Ngarimu holds a number of directorships in iwi development, rugby, the science sector, and sustainability leadership. He is currently the Deputy Chair of the Ngāti Whātua Ōrākei Trust in central Auckland.

**John Rodwell**
Director
John is an experienced director with a background in corporate finance, investment banking, and investing in agri-businesses.

**The Honourable Kate Wilkinson**
Director
Kate is a former Member of Parliament and Cabinet Minister. She was appointed Commissioner of the Environment Court in May 2015.

# Our Leadership Team

**Richard Gordon**
CEO
Richard is passionate about good science making a positive difference for society and the environment.

He became Chief Executive in 2011 after 5 years as Science General Manager.

**Justine Daw**
GM Partnerships
Building successful external partnerships and co-leading our science portfolios.

**Peter Millard**
GM Science
Developing new research collaborations and co-leading our science portfolios.

**Steve Lorimer**
GM Development
Funding, investment and commercialisation leadership.

**Nigel Thomson**
GM Corporate Services
Ensuring the sustainable and efficient operation of our organisation.

**Fiona Carswell**
Chief Scientist
Leading our high-performing science teams.

**Holden Hohaia**
GM Māori Partnerships
Building strong and mutually valuable partnerships with Māori.

**Kylie Hansen**
GM People & Culture
Building a great culture with great people.

**Chris McDermott**
GM Brand & Communications
Building one of New Zealand's great brands.

# Our Ambitions for New Zealand

Our Biodiversity • Our Biosecurity • Our Land • Our Environment

# Four Ambitious Goals

Delivering on our core purpose requires exceptional science and research spanning a wide array of scientific disciplines. Our four ambitions are designed to present our science and research in an approachable and meaningful way, for all New Zealanders to engage with.

On the following pages, we present brief highlights of our science and research in support of each of our four ambitions, together with a series of more detailed 'Innovation Stories'. These Innovation Stories are also available in a longer form, often with accompanying videos, on our website: manaakiwhenua.co.nz/innovation

Hoplodactylus maculatus *known as the common gecko.*

# Our Biodiversity

We know, value and actively preserve our unique biota and ecosystems

**We want New Zealanders to know about, value and actively care for our unique biota and ecosystems.**

Aotearoa has a rich biodiversity, from the smallest bacterium to the largest kauri tree, but it is under threat from pressures such as invasive species, climate change, land-use intensification and conversion, mining, and urban development. Discovering, protecting, and restoring this precious taonga requires exceptional science and infrastructure, practical policy, real-world tools, and solutions, and everyone's support and participation.

We collaborate with the Department of Conservation (DOC), the Ministry for Primary Industries (MPI), regional councils, iwi, wildlife sanctuaries, non-governmental and community groups, as well as business, to improve New Zealand's biodiversity management. We also contribute through major national initiatives such as New Zealand's Biological Heritage National Science Challenge and Predator Free 2050.

Our research provides DOC, regional councils, conservation groups, and communities with the scientific foundations needed to improve their efforts to protect the most threatened species and ecosystems. These efforts rely on a deep understanding of ecosystem resilience, tipping points, and how various threats – from climate change through to invasive species – affect native species.

## Highlights

Our research was central to the new recovery plan for the next stage of the Kōkako Recovery Programme (2017–2025). The plan will advance what has been one of New Zealand's most successful bird recovery operations, with the goal

of further doubling the number of kōkako breeding pairs, focusing on rapidly recovering population numbers to mitigate the genetic effects of small population sizes.

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We contributed to a group (including DOC, New Zealand's Biological Heritage National Science Challenge and regional councils) convened by MfE to coordinate biodiversity monitoring activity by agencies collecting biophysical data throughout New Zealand on a national 8-km grid. The group aims to develop a collective view of unbiased sampling of the New Zealand landscape for national and regional reporting, and to set terms of reference for multi-agency coordination. Such an accord will deliver cost savings, increase awareness of agency monitoring, and minimise the likelihood of friction with landowners and sector groups by ensuring a coordinated approach to monitoring and sampling.

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We provided commissioned advice to the Collaborative Working Group, who are revising the National Policy Statement for Indigenous Biodiversity on private land. Our advice concerned the critical factors to maintain biodiversity and included a series of decision trees that would prevent the further loss of biodiversity on private land. Our scientists were sought because of their ability to provide "authoritative, independent advice from recognised experts in this field". Many of our other researchers also supported the Collaborative Working Group through provision of ecological and spatial data and frameworks for how to value biodiversity, and utilise mātauranga Māori to prioritise biodiversity or understand threatened or naturally rare ecosystems.

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Land-use change can have a dramatic impact on biodiversity. We have used e-DNA techniques to characterise patterns of species richness and diversity for eight taxonomic groups across five different land-use types. Our analysis provides compelling evidence that different taxa respond differently to land-use change, and that diversity and composition are independently controlled. While reporting of objective statistics is normal for many features in New Zealand (e.g. health, crime), including aggregated, complex metrics (e.g. CPI, GDP), this is not the case for biodiversity despite our high endemism. We developed integrated measures of terrestrial biodiversity used by DOC throughout public conservation land, with regional councils adopting the same process. This is progress towards objective national reporting of biodiversity.

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Sanctuaries play key roles as exemplars and future leaders in the restoration of mainland biodiversity on non-DOC land. We studied the effectiveness of sanctuaries as a management strategy for threatened species and showed that while fenced sanctuaries provide the best outcomes, even unfenced areas provide considerable benefits for biodiversity. Also, species responses are not all equal, with some benefiting more than others. This work will inform the Crown's proposed new Threatened Species Strategy.

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We have worked with regional councils to develop new measures of environmental quality of wetlands, which are nationally applicable and standardised for State of the Environment reporting. These new measures will be used to guide regional plans, monitor their effectiveness, and assess the impact of management interventions. We have also demonstrated that small wetlands are critical for safe-guarding rare plant species. Our work challenges the simplistic notion that we need only safeguard a few large examples of functioning wetlands. Small wetlands are essential for securing a full complement of rare plant species.

## Populating New Zealand's tree of life

To help reverse our declining biodiversity we need to better understand native and introduced species. The Nationally Significant Databases and Collections, hosted by Manaaki Whenua on behalf of New Zealand, form an ever-growing repository of native and invasive species. The knowledge these assets contain underpins our ability to actively protect and manage our biodiversity. Following are some of the highlights for the collections and databases in the past year:

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We produced new online information and tools for *Saprininae* and *Carabidae* beetles, including detailed descriptions, illustrations, identification keys, and information on beetle ecology and biology. This work enables quicker, more accurate species identification by conservation managers.

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We published improved knowledge and diagnostic tools on *Saldidae* (shore bugs). These insects live in riparian habitats and are susceptible to landscape modification, so our work will improve monitoring of this key indicator species.

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Working with Te Papa, we published new information on native forget-me-nots, many of which are threatened, responding to one of DOC's highest priorities.

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We published three new checklists of the New Zealand flora (ferns and lycophytes, seed plants, and hornworts, liverworts and mosses). The first of their type for New Zealand, these lists respond to a key information need for end-users (DOC, MPI, the Environmental Protection Authority).

# DNA sequencing unveils past environments

**Manaaki Whenua has a long history of using microfossils to reconstruct past environments. Information about the past helps us improve our understanding of how current ecosystems function, and provides pre-human baseline information which can inform conservation and restoration planning.**

More recently, ancient DNA (aDNA) analysis has been added to the traditional microfossil toolkit, and provides a new and unprecedented level of information about the past that was previously unobtainable with microscopes.

Manaaki Whenua's Long-Term Ecology Laboratory has been using aDNA analysis on a range of materials, including sediments taken from wetlands, caves and lakes, and preserved droppings from extinct and threatened birds and introduced rats.

## Marsden Project on kiore droppings

DNA sequencing from ancient kiore (Pacific rat) droppings is giving Manaaki Whenua scientists unique insights into the ecological impacts of New Zealand's first naturalised invasive species.

A small rock cavity in Central Otago contained hundreds of 750-year-old kiore droppings. Analysis of these droppings is providing a fascinating snapshot into what the first rats in New Zealand were eating, and their environmental impact on birds, plants and invertebrates.

More droppings have since been found in the North Island, allowing our scientists to explore dietary change of an invasive species through space and time in a globally unique setting.

## Threatened species

Manaaki Whenua scientists are supervising an Auckland PhD student based at Lincoln (through the joint University of Auckland – Manaaki Whenua Centre for Biodiversity and Biosecurity) to extract aDNA from kākāpō droppings (coprolites) dating back 2,000 years to see how the ecology and diet of these enigmatic parrots have changed over time, to help inform their conservation.

The ancient droppings were collected from cave entrances where kākāpō once roosted and are being compared with contemporary and historical droppings collected by DOC, who are close collaborators in the project. This long-term view of kākāpō diets could help expand options for where populations might survive in the future.

Gut parasites also have implication for the health of the birds, and Manaaki Whenua scientists are sequencing DNA from the coprolites to establish what the natural parasites of kākāpō were.

*Palaeoecologists Dr Michelle McKeown and Dr Jamie Wood work on extracting core soil samples in wetlands off the Kepler Track in Te Anau, Southland.*

# Te weu o te kaitiaki

(The roots of the guardian)

**Manaaki Whenua has been working with the Tūhoe Tuawhenua Trust and the Ruatāhuna community to develop and test a complementary forest monitoring package using both mātauranga Māori and scientific approaches.**

Our goal was to represent a Tuawhenua world view that would reflect how people understand, relate to, and interact with their forests, as well as developing a monitoring system that would measure changes in the forests that mattered to the Tuawhenua people.

A cross-cultural monitoring system provides understanding of forest state that both managers and communities can use for decision-making. It provides an opportunity for indigenous peoples and local communities to apply their traditional ways of knowing, and interprets and acts on information they understand as crucial components of cross-cultural environmental management regimes. Historical baselines of forest state provide ecological targets for restoration initiatives, and also identify where on the restoration continuum current forest indicators lie. The future challenge for the Tuawhenua people, and Māori, is to ensure their world views, values, and methods for understanding the environment influence current conservation and environmental management systems.

Our study supports the use of te ao Māori that not only enrich, but also help maintain our cultural heritage and enhance cultural diversity and protect the well-being of Māori.

*Maioha Timoti and Te Aotarewa Timoti pluck possums off a trapline in Ruatahuna, Te Urewera.*

# Our Biosecurity

Our land is protected from invasive biological threats

**We want New Zealand to be protected from invasive biological threats.**

Our native biodiversity and our ability to derive income from primary industries are constantly threatened by invasive weeds, pests, and diseases. Manaaki Whenua collaborates with many partners as part of our drive to help New Zealand reach its Biosecurity 2025 and Predator Free 2050 goals.

Our research focuses on border security for early detection and prevention, and improving control methods for established invasive species. We recognise the need to gain social licence for new and emerging control methods, and this requires effective engagement with New Zealand communities.

Manaaki Whenua's global reputation as a world leader in invasive species management continues to grow through our engagement with the International Union for the Conservation of Nature.

*Caterpillar of the Honshu butterfly, Limenitis glorifica, beginning to form a cocoon.*

## Highlights

In concert with the New Zealand's Biological Heritage Science Challenge we led the development of the national research strategy needed to be able to achieve a predator-free New Zealand by 2050. We have also advised regional councils on the steps needed to eliminate predators and how these can be integrated with other biodiversity restoration initiatives.

We are pleased to lead two of three new DOC-funded 'PF2050 tools to markets' projects to help make new predator control tools safer and more cost effective, or to enlarge their scale. The first project aims to extend a Norway rat-specific pesticide so that it also targets ship rats. The second project will evaluate the potential sensitivity of native birds to a new type of bait in order to underpin the toxin's potential development for aerial stoat control.

We presented to 400 Waikato Regional Council staff on the steps needed to achieve Predator Free 2050 and how these can be integrated with other biodiversity restoration initiatives. The council has declared six strategic priorities, one of which is a predator-free Waikato by 2050.

Working with New Zealand's Biological Heritage National Science Challenge, we have conducted a large-scale whole-animal assay of stoat behavioural responses to ferret odours, sourced from a range of different ferrets. By analysing the behavioural data against the chemical data, we will now identify the critical chemicals on which to base a synthetic stoat lure.

We successfully demonstrated an oral vaccine against TB in cattle. Vaccination was trialed in free-ranging New Zealand cattle exposed to wildlife TB and resulted in 67.4% efficacy in preventing infection and a slowing disease progression.

We used global databases of more than 16,000 invasive species to determine changes over time of emerging threats. The rate of emergence of new invasive species is still high and cannot be explained by imports from historically important source regions. Instead, emerging threats reflect expanding trade networks and environmental (especially climate) change. MPI are using this work to consider changes to the national biosecurity risk assessment tools.

### Collections and databases key to New Zealand's biosecurity

The Nationally Significant Databases and Collections hosted by Manaaki Whenua on behalf of New Zealand form an ever-growing repository of knowledge of what species are present in New Zealand. This knowledge is critical when a biosecurity incursion – the unwanted arrival of invasive species – is suspected. Following are some of the highlights for the collections and databases in the past year:

We worked with Plant & Food Research to develop a strategic framework for botrytis research. Working with about 20 key researchers from New Zealand, France and the Netherlands, and New Zealand wine leaders, we identified the highest priority botrytis research to help grow the New Zealand wine sector. This work has important implications for vineyard management.

We produced new online information on Noctuidae moths, *Lusius* micro-wasps and Ceratomerinae flies, which enables the biosecurity system to more easily differentiate native species from invasive species at the border, avoiding costs to industry and ensuring ongoing market access for New Zealand exports.

Many species, particularly fungi and micro-organisms, are wrongly identified as 'being present' in New Zealand (or the reverse). This adds to biosecurity risk and can send conservation efforts down the wrong track. We recently undertook a project on the genus *Phoma*, a taxonomically difficult genus of plant pathogenic fungi of biosecurity importance. Using new genetic techniques, we corrected the status of earlier morphologically based 'present in NZ' records for fungal specimens that had been incorrectly identified.

# Science key to the national myrtle rust incursion response

Myrtle rust is a plant pathogen that can devastate pōhutukawa, rātā, mānuka, kānuka, and other native trees. New Zealand is particularly at risk from this disease as trees in the myrtle family are highly represented in our forests. Not only can the disease affect the environmental values of our forested landscapes, but it potentially has economic implications for New Zealand's high-value honey industry.

Manaaki Whenua has been involved in a number of ways to support the national response to the myrtle rust incursion. We assembled distribution data (75,000 records) for native myrtle species from our Nationally Significant Databases, and summarised their contribution to ecosystem diversity and carbon storage (sequestration). Mapping where tree species may be susceptible to the disease and areas where the disease is expected to have the highest impact is key to any national incursion response. Both DOC and MPI are using our preliminary maps to assess risk and identify best management options. DOC has also used our research to assess where native honey eaters (such as bellbirds and tūī) are likely to be most affected by myrtle loss – a key consideration given that food availability is critical to species conservation and recovery.

*Field technician Morgan Coleman and intern Taina Goldsmith search for tagged mānuka in a National Park near Nelson Lakes.*

# Research critical to virus release

**Manaaki Whenua scientist Janine Duckworth's work helped support this year's release of the RHDV1-K5 rabbit calicivirus in New Zealand.**

Approval to release the RHDV1-K5 virus in New Zealand was applied for by Environment Canterbury on behalf of the Rabbit Coordination Group, comprising regional and district councils with rabbit-prone areas, DOC, Land Information New Zealand, and the High Country section of Federated Farmers. Dr Duckworth assisted the group with the application and the development of a release strategy for RHDV1-K5. Key factors in the strategy included ensuring a high-quality commercial product was available, determining optimal release times when potential vector fly populations were high and the number of young rabbits (which could potentially acquire immunity) was low, selecting appropriate release sites, and using methods of bait deployment to maximise the uptake of the virus-treated baits.

Manaaki Whenua also worked with regional councils on pre- and post-virus release monitoring of rabbit numbers and researching the role that flies play as vectors moving the virus across the New Zealand landscape.

*Field technician Grant Morriss and intern Florian Chazottier collect a bone marrow sample from a recently deceased rabbit in Glentanner, in the Mackenzie Region.*

# New methods help in kauri dieback management

**Kauri dieback disease has spread quickly over the past decade, killing thousands of kauri. The *Phytopthora agathidicida* pathogen was first identified on Great Barrier Island in 1972, with Manaaki Whenua's Dr Bevan Weir leading the description of the 'kauri killer'.**

The pathogen lives in soil and attaches to the trees' roots, starving them from below. This gives it the appearance of a thinning and yellowing of the crown, and a characteristic over-production of gum at the collar.

Manaaki Whenua scientists have spent the last 10 years researching kauri dieback, and the research team, in collaboration with Māori partners, have looked at the fungi and microbes associated with healthy kauri to see if they could develop a natural resilience in infected trees through corrective changes of post-biotics.

Scientists have infected seedlings taken from North Island kauri in a glasshouse to determine the survival rate and assess whether there is any natural tolerance in the remnant populations.

Infected kauri do not show symptoms of the disease straightaway – in the past it has taken up to a month to test if the pathogen was in the soil. Now scientists can put cedar needles over a flooded soil sample, and if the pathogen is there it swims to the needles. The needles then have DNA extracted and purified, which is analysed using LAMP/isothermal primers. The advantage of this technology is that it is portable – meaning analysis can be done in the field.

This is a huge step forward for researchers, because knowing where the infection is present helps them determine how the pathogen behaves and where its next target might be. The nature of the test means it can be done without specialist, selective agar and can be deployed in remote situations, as the test unit is linked to a smart phone, so results can be issued via email.

The long-term goal with this research is to minimise the impacts of kauri dieback, and to enable mana whenua, conservation staff or landowners to test the soil and make more informed land management decisions about containment or quarantine.

*Researcher Stanley Bellgard stands beneath the beautiful 'Aunt Agatha' in the Cascades Regional Park in West Auckland. The tree was healthy when this photo was taken, but has since succumbed to kauri dieback disease.*

# Landscape predator control pays off

**Large-scale landscape predator control is a vital component of many restoration projects across the country. The Poutiri Ao ō Tāne, Cape to City programme in Hawke's Bay is a great example of a collaborative approach to work to improve biodiversity, underpinned by Manaaki Whenua's research and expertise.**

The programme's partners include Hawke's Bay Regional Council, iwi, Aotearoa Foundation, and DOC, along with Manaaki Whenua.

The programme is a vital part of Predator Free New Zealand and has been chosen as one of the first exemplar sites for demonstrating predator eradication in New Zealand.

The programme features large-scale predator control across 53,000 hectares of private land surrounding Boundary Stream Mainland Island on the Maungaharuru Range, and public land between Havelock North and Waimārama Beach.

The control is carried out for a low cost and focuses on feral cats, stoats and ferrets, with intensive rat control undertaken in specific locations.

Innovative science includes traps that use satellites and cellular technology to alert mobile phones when a trap has been sprung, and motion-trigger cameras to monitor predator pest numbers.

Computer modelling helps with trap placement to ensure maximum predator kills for a given cost.

Alongside predator control there has been native replanting and translocation of native bird species, including robins, tomtits, and petrels.

Manaaki Whenua's use of eDNA (environmental DNA) techniques allows the programme to extract DNA from soil samples to reveal what species of flora and fauna are in the area.

Manaaki Whenua is also undertaking social research to try to understand the motivators, or barriers, for people's involvement in biodiversity restoration on private land.

An added benefit for farmers may be a reduction in toxoplasmosis levels in sheep. Toxoplasmosis is spread by cats and causes lamb abortions. Manaaki Whenua is monitoring to see if it declines with feral cat control.

Over three years there has been a steady increase in bird, lizard and invertebrate numbers. Kākā, kākāriki, robins and petrels have been translocated into Poutiri Ao ō Tāne and are doing well. Robins and tomtits have been translocated into Cape to City, and the robins are also doing well there. Not enough time has elapsed for the predator control to have had wider effects on birds at this stage.

*New Zealand robin, toutouwai, perches on a branch waiting for prey.*

# Our Land

## We use our land, soil, and water resources wisely

We want New Zealanders to use our land, soil, and water resources wisely. Some of our most important natural resources have reached critical environmental thresholds because of unsustainable land-use practices. Finding a healthy way to balance land and ecosystem use is critical to ensuring our future prosperity.

We need improved knowledge of how the land responds to human pressures, potential limits to land-use intensification and other development, and what drives natural resource management decisions. This will improve the primary sector's economic and environmental performance, and will support the provision of wider ecosystem services.

By drawing on and enhancing the value of our Nationally Significant Databases, our research increases the availability of authoritative information on New Zealand's land-based resources to more accurately understand and manage the pressures on our land and soils, improve environmental reporting, and deliver pathways to more sustainable land-use.

The land supports New Zealand's wealth and well-being, but we still have some way to go to fully map our diverse soils and landscapes and understand how they function. Manaaki Whenua's work to describe our land and soils directly informs land management policy and regulation set by government agencies and councils, and enables landowners and iwi to make sustainable land management choices.

*Research technician Graeme Rogers collects soil core samples at Lincoln University's Ashley Dene Farm in Canterbury.*

# Highlights

New Zealand is geologically and ecologically diverse, and its landscapes and ecosystems are complex. As the Crown Research Institute for the land environment, Manaaki Whenua is working hard to ensure New Zealand has the science and information it needs to understand the complex and multiple pressures on our valuable land and soils, and land-based biodiversity and ecosystems.

Manaaki Whenua provides decision-makers and land managers with access to cost-effective, integrated science solutions to manage the land wisely for future generations. We invest in this work ourselves, and also partner with a wide range of government, Māori, and primary sector partners.

### Improving New Zealand's soil data

Soil data underpin many land management decisions. High-quality, accurate soil data are critical to setting new policies and regulation to manage nutrient loads, to increasing the accuracy of the nutrient budgets produced via Overseer™, and to improving land management practices on farms.

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Manaaki Whenua leads New Zealand's soil characterisation and mapping research. Through our S-map National Soil Mapping programme we increased the geographical reach of S-map soil data (e.g. in Marlborough). We also improved its usability by making major improvements to S-map Online, the online soil data portal, including: access to summaries of soil type by individual property; and the ability for landowners to automatically locate 'their' soils using cellphone GPS and to use an app to identify and download data for specific on-farm areas of interest.

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The number of users of our soils maps and other products continues to grow, with over 10,000 registered S-map Online users, 35,000 factsheets produced, and 3,000 monthly users, with around 66% of these being repeat users. Approximately 10% of all users are now accessing our soils information from tablets or smart-phones, reflecting mainly on-farm usage. S-map soils data have also supported 55,000 data requests by Overseer™ users.

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In a significant project, we uploaded legacy information on soil profiles to our National Soils Data Repository (NSDR), with data derived for use in S-map, our national soil-mapping programme. This resolves a key knowledge gap on the water-holding capacity of our soils. The behaviour of water in the various soils across New Zealand can now be more accurately predicted, and used to ensure greater accuracy in models such as Overseer™ to predict nutrient (nitrate) losses for soils, and the Dairy Effluent Pond Calculator, which aims to help farmers manage land application of dairy effluent.

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We completed a stocktake and review of the Hawke's Bay Regional Council's soil quality and trace element State of the Environment monitoring programme. This is an essential step to improve the national consistency of soil quality and trace element monitoring and data management to support the development of National Environmental Monitoring Standards.

### Enabling more sustainable use of the land

Manaaki Whenua's research informs everyday decisions by landowners. In particular, we provide the broad-scale data about the land environment that are needed to support farm environment plans and more sustainable land management practices.

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We completed land-use maps for land adjacent to the Tukituki and Waipawa Rivers. This has enabled landowners in the Tukituki catchment to complete their Farm Environmental Management Plans and nutrient budgets before the Plan deadline of 30 June 2018.

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We provided training workshops for Northland, Auckland, and Hawke's Bay Regional Councils on a soil erosion mitigation optimisation tool we have developed to inform farm plans. We also discussed planned enhancements to SedNetNZ, our national sediment model. Feedback on the new tool was very positive because it enables councils to do work in minutes rather than weeks.

# Combating wilding conifers

**Wilding conifers are a huge threat to New Zealand's environment. The non-native trees, also known as wilding pines, now invade more than 1.8 million hectares of land.**

Planted in the right place, conifer trees can provide timber, store carbon, decrease erosion, filter soil nutrients, improve water quality, and provide shelter for stock. However, spreading on their own, they are a major threat to our ecosystems, land and farms – killing native plants and evicting animals – and are estimated to cost our economy $1.4 billion over the next 20 years.

Despite control efforts, wilding invasion continues to spread over an estimated 90,000 more hectares a year. If left untreated, wilding conifers will cover almost a quarter of New Zealand in two decades.

Stopping this spread is a major problem, but researchers say it is possible through intervention across all stages of invasion. In 2016 the National Wilding Conifer Control Programme was established to ensure a collaborative, coordinated and effective approach to national wilding management in New Zealand with the goal of preventing any further spread and efficiently containing or eradicating established areas of wilding conifers by 2030.

Manaaki Whenua works collaboratively on this national issue with MPI, Scion, DOC, and universities and leads the 'Winning Against Wildings' programme, which involves integrated research focusing on tools for wilding conifer management and ecosystem restoration.

Over the last year our researchers have been working in problematic areas in the Mackenzie Basin and Hanmer Springs, with a focus on measuring the ecological and environmental impacts of major wilding conifer species, better linking research and management on control methods, and integrating what we know about invasions and management through modelling.

They are also working to develop stage-specific tools to maximise the efficiency of detection and management, prevent further invasion, and ultimately protect and restore ecosystems. This information is then used to forecast when and where interventions can achieve desirable long-term outcomes while minimising both costs and negative impacts.

The overall aim of the 'Winning against wildings' programme is to integrate work across all stages of the invasion process to make management most effective, and to prevent future problems of wilding invasions.

This research is funded by MBIE, with support from MPI, DOC, the Wilding Conifer Management Group, and the Forest Owners' Association.

# Honey presents golden opportunities

**Mānuka and kānuka honey are in high demand worldwide, and Manaaki Whenua is working with Māori landowners on ways to derive further value from local varieties.**

Research is taking place on the genetics of mānuka and kānuka to allow landowners and apiarists to use science to describe the uniqueness of honey sourced from their district. The research looks at the unique properties of each area's varieties, allowing producers to tell their local origin stories.

With the danger presented to the industry by the incursion of myrtle rust, this genetic research has a renewed importance as we look at the genetic diversity of mānuka and kānuka. This research may help to identify seed stock that is resistant to the fungal invader.

Other research aims to help reduce colony losses by determining optimal stocking rates for bees. With average bee colony losses of about 10%, this is important for reducing hive collapse and ensuring profitability for apiarists.

*Lab technician Caroline Mitchell works in the Lincoln GEM lab to extract DNA from mānuka.*

# Land Domain Report collaboration

**Manaaki Whenua contributed many of the data sets, computer models, and peer-reviewed science that underpinned the Our Land report.**

Working with other research providers and sector stakeholders, and with assistance from MBIE's national science funding, we lead large-scale research programmes that underpin environmental reporting to accelerate the delivery of high-quality soil mapping, soil health, erosion and sediment, and land-cover data and information.

Our contribution to the report included providing five staff members for science advice support and seconding one staff member to work on the report.

The Manaaki Whenua team worked to ensure that the data, science, and models used to underpin the report were both up-to-date and appropriately interpreted. This report is important because it represents the first dedicated State of Environment report on the land environment. It is an important synthesis of knowledge on the state of New Zealand's terrestrial biodiversity, ecosystems and soils, and pressures such as urban expansion on versatile land, productive land intensification and soil erosion. As a result of this report, the awareness of threats to our land resources led the Minister for the Environment to call for a new National Policy Statement on versatile land and high-class soil. Manaaki Whenua will continue to provide the support for this major policy development through scientific evidence.

# Remote sensing utilised

**Manaaki Whenua has a long history of research leadership in environmental monitoring from space, using state-of-the-art remote-sensing technologies, satellite imagery, and smart science to cost-effectively map the vegetation (land cover) across the length and breadth of New Zealand.**

Along with Venture Southland, NASA, and the NZ Space Agency, we co-hosted the second-only national colloquium on Earth observations (remote sensing) in March. The conference aimed to showcase New Zealand's Earth Observation industry capability, and its potential applications to improve monitoring of the condition of New Zealand's environment, better spatially quantify the human pressures on the environment, and optimise land-based primary production .

New Zealand is the size of Japan or the United Kingdom, with fast-changing land use. Increasingly, we are using new methods to improve the scale, accuracy, and utility of the land information and mapping we produce as a result of our remote-sensing research. Last year, for example, we used new remote-sensing methods to deliver the first nine regions of mapping needed to develop an updated Land Use Map of New Zealand. This information is critical for the Ministry for the Environment to accurately identify land- use changes over time in New Zealand for greenhouse gas reporting, to model the impacts of changing land use on water quality, and to inform land and water policy development.

Advances in technology are seeing much greater use of remote-sensing technology by Manaaki Whenua in everyday work.

Fixed-wing and multi-rotor drones are being used for aerial survey work, equipped with cameras, digital sensors, and mobile laser scanners, while use is also being made of satellite and radar images.

Data collected include information on indigenous forest classes for biodiversity and pest control research; shrubland classes for use in weed control and to help with mapping mānuka and kānuka areas for the honey industry; indigenous grasses for biodiversity management; woody vegetation for pest control and soil conservation; pasture productivity for agricultural management; bare ground for soil erosion monitoring; and wetlands for biodiversity management.

*Left: Soil scientist Dr Sam Carrick pours water into a defined area of soil to measure the absorption rate at Manaaki Whenua in Lincoln.*

*Right: Remote-sensing scientist Ben Jolly sets up a RPAS 'drone' for a remote-sensing operation in Palmerston North.*

# Our Environment

We are an environmentally informed nation taking action together

We want New Zealand to be an environmentally informed nation, taking action together. As New Zealanders, we are proud of our clean, green image and aspire to lead the world by our example. This is tempered by an increasing awareness of just how fragile our environment is.

To make real improvements we need reliable data and indicators and decision-making processes that account for the complexity and uncertainty surrounding our environment, along with practical action. New Zealand's economic development can only be sustained if ndustries and businesses operate within complex environmental limits.

The work done by Manaaki Whenua is designed to support Māori, business, and community groups to be a part of making decisions on the future uses of and values relating to our environment. We must balance the needs of multiple and diverse stakeholders, including national and local government, the private sector, Māori and local communities in making decisions about our environment.

As a country, we must also focus on our commitment to meet our international greenhouse gas obligations. New Zealand will meet its responsibility targets through a mix of domestic emissions reductions and the removal of carbon dioxide by forests, and participation in international carbon markets. To achieve this, we will need a robust inventory of net emissions and carbon storage at a national scale, and appropriate mitigation tools. Our research focuses on measuring and modelling the environmental and economic impacts of emissions reduction and developing effective mitigation options for reducing net emissions.

## Highlights

Soil carbon offers an important mitigation option against greenhouse gases, but is vulnerable to loss as soils warm due to climate change. We have shown that in pastures only the recent input of carbon from plant roots is vulnerable to such a loss, while the older, stabilised carbon is less affected. These findings have important consequences for models predicting the feedback between climate warming and soil carbon dynamics, and they are being evaluated.

We chaired a technical advisory group for the Food and Agriculture Organisation of the UN (FAO), comprising 37 researchers from 27 different countries, to draft Guidelines for Measuring and Modelling Soil Carbon Stocks and Stock Changes in Livestock Production Systems. These guidelines aim to give a harmonised, international approach for estimating soil organic carbon (SOC) and stock changes. Despite the attention given to SOC, current knowledge remains fairly limited regarding SOC baselines and changes, the detection of vulnerable hot spots for SOC losses, and opportunities for SOC gains under both climate and land management changes. Accurate baselines are still missing for many countries, and estimates of carbon fluxes due to changes in SOC stocks in the global carbon cycle are associated with large uncertainties. There is high variability in reported values, caused by the diversity of data sources and methodologies used. The guidelines will soon be disseminated by the FAO for individual countries to adopt.

In a widely welcomed and used policy brief, we synthesised learnings on freshwater management in New Zealand from 6 years of research in our MBIE-funded Values, Monitoring and Outcomes (VMO) programme. The policy brief provides government agencies, councils and communities with key insights into how new freshwater policies have driven changes in the way freshwater resources are managed in New Zealand; changes in the role of local government authorities; the science needed to support community-led decisions on freshwater quality limits in local catchments; and changes in the way communities are involved in both policy and decision-making.

With the aim of improving New Zealand's international greenhouse gas reporting, we worked with MPI to verify the studies and calculations used to create the manure management methane emission factor for deer in the National Inventory, and provided background data and calculations used to derive this emission factor value originally, as a comparison.

We co-authored several elements of an integrated assessment report on National Systems Analysis for Identifying Feedback Loops, Understanding Cumulative Impacts and Recognising Limits. The report synthesises the latest state of scientific knowledge on likely climate change impacts for New Zealand, and what it means in terms of ecosystem services, costs for society and other impacts.

We have reviewed and summarised results from three research projects to draw some conclusions about the likely effects of future climate change on soil carbon in New Zealand's grasslands. These findings have important consequences for models that predict the impacts of climate change on feedbacks between soil carbon stocks and atmospheric $CO_2$ concentration, and will help inform the new government's climate change policy for the primary sector.

Using new remote-sensing methods, we delivered the first nine regions needed to develop a 2016 Land Use Map of New Zealand. These were provided to MfE to more accurately identify land-use changes over time in New Zealand, enabling more accurate greenhouse gas reporting and informing both policy and modelling of the impacts of land use on water quality.

The latest Colony Loss Survey seeks to quantify bee colony losses over winter 2017, augmenting earlier (2015, 2016) national surveys. Our analysis showed that bee colony losses over winter 2017 are statistically indistinguishable from those in earlier winters. However, colony loss rates critically depend on both space and operation size. In this survey, we were able to better identify the causes of colony losses, with starvation emerging as a key concern. Rising mānuka honey prices, overcrowding, and competition for pollen and nectar sources are problematic due to hive numbers reaching record highs (and growing) in 2017.

We produced a report for Fonterra's Social Responsibility and 'Less Footprint' teams to better understand the risks and opportunities related to ecosystem services on the farm. The report will help Fonterra identify priorities for future sustainability-focused incentives, policies, and farm management practices for suppliers, as well as potential adoption pathways.

# Wai Ora Wai Māori app launched

**Developing a deeper understanding of the state of Māori natural food and traditional resources was the drive behind the creation of the Wai Ora Wai Māori app.**

The app was designed as a kaupapa Māori assessment tool for Ngati Tahu – Ngati Whaoa to simplify the involvement and empowerment of iwi in freshwater decision-making. It enables the user to assess the condition of freshwater from a te ao Māori perspective.

Developed and tested in the Waikato, the tool helps whānau to measure progress towards restoring and enhancing the mauri (life force) of their mahinga kai (food-gathering place). Data collected with Wai Ora will help whānau prioritise activities for restoration and future management programmes.

After a successful release to Ngati Tahu – Ngati Whaoa in December 2017, the framework has now been given to Tapuika iwi, who are customising the tool for their own use.

The app is used to assess the resource condition in relation to human activities and land management practices. It is also being used to measure and assess trends towards specific iwi goals and objectives for resource, taonga species, or a culturally significant area.

*Kairangahau Māori Kiri Reihana shows off the Wai Ora Wai Māori app, a kaupapa Māori assessment tool designed for Ngati Tahu – Ngati Whaoa.*

Used alongside scientifically based quantitative attributes and measures, the tool provides a robust, holistic, and complementary data set to inform freshwater management to measure progress towards iwi environmental aspirations.

The app has also has become a te reo support tool for their people: in the tutorial, when a word is selected for the rating it is then translated into Māori.

Iwi are keen to participate actively in the decision-making process when setting limits and regulations to ensure people can continue the traditions and eat the kai of their ancestors. In their role as kaitiaki, Ngati Tahu – Ngati Whaoa want to ensure the mauri of their environment and resources is kept intact. Through respectful management, our environment and mahinga kai will have the ability to sustain themselves and support whānau who gather kai to eat and share with others.

# Soil carbon research

Globally, soil scientists have turned their attention to soil carbon research to investigate how much is contained in soils and how best to retain or increase soil carbon stocks. Any increase is a direct offset to greenhouse gas emissions and could be accounted for in national accounting and emission trading schemes.

Researchers estimate that a 0.4% increase in soil carbon per year could halt the increase in carbon dioxide concentrations in the atmosphere related to human activities. This largely aspirational '4 per 1000' goal, announced at the climate change meeting 'Conference of the Parties 21' in France in 2015, is incentivising researchers to think widely about methods to increase soil carbon stocks in our managed soils, together with methods to monitor any soil carbon stock changes through time.

Soil carbon stocks can be highly variable from place to place in the landscape, and so their accurate estimation for a target area must take account of this spatial variability to be statistically robust.

Our approach has been to spatially optimise sampling positions and then use a rapid soil spectral analysis method to measure soil carbon at these sampling positions and provide a mean soil carbon stock estimate.


*Palmerston North-based pedometrician Matteo Poggio operates the soil core scanner. Its sensor technologies rapidly scan soils and estimate soil organic carbon stocks.*

# Strategy 22

## Our 5-Year Strategy

Strategy 22 was developed in 2017 as a 5-year strategy to guide key investment within the organisation to 2022. The strategy comprises nine strategic goals, including four foundation goals: Our People, Our Partners, Our Infrastructure, and Our Sustainability; and four science goals:  Innovative & Challenging, Valued & Trusted, Strategic & Integrated, and Engaged with all New Zealanders. Underpinning these eight goals is a ninth goal: Science Working with Mātauranga Māori, indicating the value of incorporating a Māori world-view into all our work.

**By 2022 we aim to be:**

—
respected and valued nationally and globally for our excellent and relevant research

—
a credible and trusted voice contributing evidence in matters of public concern

—
recognised for tackling hard issues and science and being innovative, responsive, and adaptable in our approach

—
an employer of choice attracting and retaining exceptional talent, and a preferred partner of Māori

—
a household name known for unique stories that inform, inspire, and engage the public

—
an integrator skilled in bringing together multi-disciplinary teams and stakeholders to solve complex issues

—
financially sustainable and using integrated reporting against our sustainable development goals.

# Science Working with Mātauranga Māori

Māori have been kaitiaki of Aotearoa for generations, and by incorporating a Māori world view into our work we can better understand our land, environment, and biodiversity

Manaaki Whenua has developed enduring partnerships with selected iwi, groups of iwi, Māori trusts/incorporations and Māori organisations. These partnerships support and contribute to our partners' aspirations. We engage regularly with these groups in the spirit of partnership, as expressed in the principles of the Treaty of Waitangi.

We seek to understand and respond proactively to the needs of our Māori partners, including novel approaches, e.g. through secondments and new commercial models. We increasingly co-design our science and research programmes with our Māori partners. We build on and add value to the platforms, tools and technologies of our Māori partners to grow joint intellectual property beneficial to New Zealand. Our people have the skills and characteristics to engage well, deliver value, and support our Māori partners.

## Effective engagement with Māori

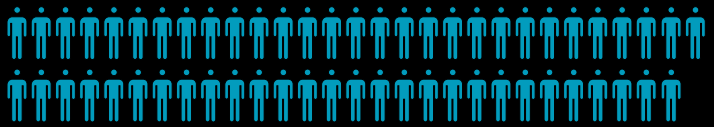
During 2017/18, Manaaki Whenua has continued its extensive programme of engagement with iwi and Māori stakeholders, including pre- and post-settlement tribal governance entities, Māori land trusts and Māori incorporations.

NOHO MARAE VISIT

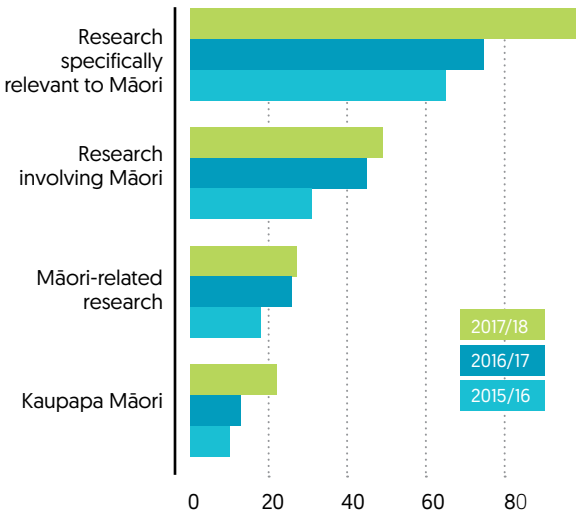
= 1 person

TREATY OF WAITANGI WORKSHOP

TE REO & TIKANGA WORKSHOPS – 3 HELD



VISION MĀTAURANGA PROJECTS




### Climate-resilient Māori land

We worked with Māori landowners in the Waiapu river catchment in Te Tairāwhiti to identify future land investment opportunities that account for climate change. Our methodology involved confirming Māori owners' aspirations and core values for their land, and using these and a range of other variables (e.g. climate uncertainty and erosion susceptibility) in the NZFARM model to assess viability of options. The result was a strong preference for mixed indigenous forestry, with its range of short-term revenue streams (e.g. honey and kawakawa extracts), as well as longer-term, intergenerational benefits (e.g. selective timber harvest, biodiversity enhancement and water quality).

### Working with Taranaki iwi to co-design research programmes based on iwi aspirations

We continue to develop our relationship with iwi in the Taranaki region (particularly Ngāti Tama, Ngāti Mutunga, Ngāti Maru, Te Atiawa, Taranaki, and Ngārauru). In this region, while we are already heavily involved in the Mounga Project, we are also seeking to grow a cross-iwi environmental forum whereby iwi themselves help inform and co-design our research based on their environmental aspirations. Recent engagement indicated strong interest in freshwater ecology, impacts of dairy farming on local waterways (including assessment of nitrogen limit-setting schemes), protecting against myrtle rust (Ngāti Mutunga have the southernmost naturally occurring stand of pōhutukawa in their rohe (district)), and a range of other long-standing environmental concerns that Manaaki Whenua could help them with.

### Diversifying from dairy – Parininihi ki Waitōtara (PKW)

We have established a promising working relationship with PKW and are now looking to undertake a detailed, multi-disciplinary assessment of land-use options that factor in the need to diversify from the dairy platform. While the work will focus on one particular farm in the PKW portfolio, we anticipate the findings will have broader applicability to other landholdings across the region. This aligns perfectly with PKW's stated strategic direction to reduce their reliance on dairy as their predominant land-use activity. This programme is a collaborative effort led by Te Ara Pūtaiao, the cross-CRI Māori network, and, so far involves Plant & Food Research, NIWA, Scion, and GNS.

### Working with iwi in the fight against kauri dieback

Manaaki Whenua has been invited to participate as a standing member on Te Kāhui Rangahau o Ngāti Whātua (Ngāti Whātua Research Collective) and to contribute its kauri dieback expertise and broader capability to the fight against the disease. We have been actively working with iwi groups both via this collective and directly. This has included Te Kawerau a Maki, who recently placed a rāhui (ban) on the kauri forests in the Waitakere Ranges. Manaaki Whenua is working with this group to measure the effect of human exclusion on spread of the disease. We have also formed advisory relationships with Te Roroa around options for protecting Tāne Mahuta and the surrounding area in the Waipoua Forest in the Hokianga.

### Iwi Science Panel – Te Kāhu o te Taiao

Manaaki Whenua is delighted to announce that we have established a formal arrangement with Te Kāhu o te Taiao (the Iwi Science Panel – an expert advisory group nominated and endorsed by members of the broader National Iwi Chairs Forum). The objective of the agreement is to: (1) deepen collaboration with Māori/iwi end users of Manaaki Whenua's science, (2) identify areas for mutual Manaaki Whenua and Māori/iwi collaboration and benefit, (3) ensure Manaaki Whenua is aware of the impact and benefit of its science for Māori/iwi, and (4) enable two-way dialogue on how to ensure Manaaki Whenua science best meets the needs of Māori/iwi.

Moving forward, we will convene four quarterly hui-a-kanohi (face to face) workshops between Te Kāhu o te Taiao and key Manaaki Whenua kairangahau to provide a range of outputs to help progress these objectives. We are very excited by this new relationship and are looking forward to working with the group.

# Our People

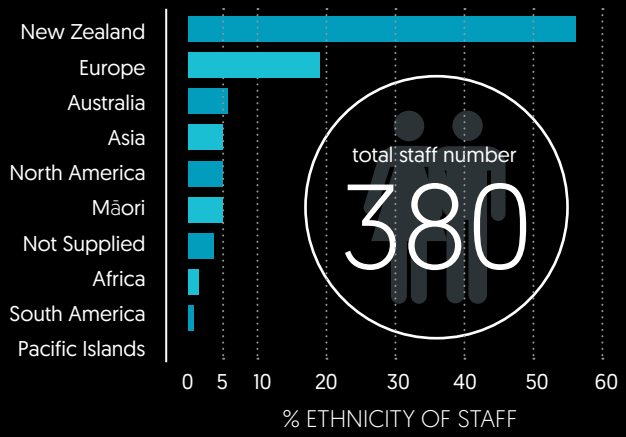
Foundation Goal

**Manaaki Whenua has a People Strategy that aims for the organisation to be an employer of choice, attracting and retaining exceptional talent.**

Our workforce is focused on providing excellent science in collaboration with its partners to achieve the best possible results for the land environment.

We have 380 researchers, specialists and support staff, and their diversity of skills, experiences and ideas contribute to the success of the organisation. Talented people from around the world regularly seek to join us.

We work hard to ensure Manaaki Whenua is a safe place to work. Health, safety and environmental considerations form a crucial part of all job planning. We regularly audit our systems and processes to ensure compliance with regulations and best practice. We actively manage succession for key roles, and have capable and committed potential successors in the leadership pipeline. Our remuneration levels are competitive with relevant market benchmarks.




*Senior soil scientist Dr Carolyn Hedley in the Palmerston North cool store.*

### Empowering work culture

We aim for an empowering culture fostered by great leadership and communication.

Each year we grow our research capability, investing in key areas to support National Science Challenges, Conservation and Environment Roadmaps, and Strategic Science Investment Fund (SSIF) objectives that include Vision Mātauranga.

Health, safety, and well-being are at the forefront of everything we do, and our leadership and staff are committed to ensuring a safe working environment.

We have invested in various health and safety initiatives, including Health and Safety Representative training, Safety Differently (an approach to developing a safety culture from the bottom up by focusing on work as done rather than work as imagined), well-being, and emergency management. We value diversity, equality, agility, and collaboration.

These principles support our commitment to being a good employer and form the basis of our People Strategy – Ko tātou tēnei. The achievements of Manaaki Whenua and its subsidiaries against the seven key elements of being a good employer are:

### Leadership, accountability and culture

We achieved a 79% response rate to this year's full employee engagement survey. Our engagement index of 70% was maintained from last year's pulse check and is in line with the CRI benchmark.

The largest gains were in the questions 'I feel I am working for a successful organisation', 'this organisation has a clear vision of where it's going and how it's going to get there', 'this organisation is making the changes it needs to be successful in the future', 'I have confidence in the senior leadership of this organisation', 'this organisation is dedicated to developing the bi-cultural capability of its staff', and 'I would recommend this organisation as a great place to work'.

Our leadership programme this year focused on an in-house coaching development programme that included workshops, seminars, and practical coaching opportunities. Tier 4 staff and our future leaders also attended a 2-day Management Essentials programme. We have a developed Equal Employment Opportunities policy that links to our values and our bicultural awareness initiatives, which consist of Treaty of Waitangi and cultural competency workshops, including a noho (overnight) marae 2-day event.

### Recruitment, selection, and induction

Our recruitment processes focus on ensuring we have the best possible leaders and staff. We have comprehensive recruitment and selection policies and procedures that are impartial and transparent, ensuring we minimise barriers and biases to further enhance our culturally diverse organisation. These were further updated this year.

Capability is important, and we focus on strategic hiring decisions that ensure we can meet future research and business needs.

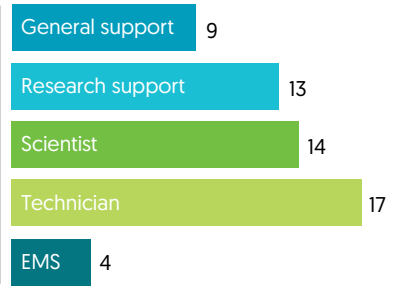
Our induction process is thorough, so employees are aware of their responsibilities and available organisational support.

### Employee development, promotion, and exit

Each year, as part of our performance appraisal and development programme, employees have at least three opportunities to discuss their career aims and aspirations, personal development, and training.

AVERAGE YEARS OF TENURE

13
all employee average tenure




Staff members have individual learning and development plans, actioned and monitored by a training coordinator.

We want to ensure that our people have regular opportunities to give feedback throughout the employment cycle, including through an exit questionnaire.

### Flexibility and work design

Manaaki Whenua supports a healthy work–life balance and provides for flexible working arrangements supported by phones and laptops to improve staff mobility.

We offer part-time, variable hours, and teleworking arrangements as appropriate.

### Remuneration, recognition, and conditions

We undertake an annual review of our remuneration policy to ensure it supports our recruitment and retention strategies.

Manaaki Whenua has an equitable, transparent, and gender-neutral remuneration system that ensures all individuals and groups have equal employment conditions.

*Soil scientist Jack Pronger clears the area around lucerne to be collected for analysis at the lysimeter facility on a Tihoi farm.*

As part of monitoring this we benchmark our salary medians against the CRI, science, and general market sectors and also provide annual performance bonuses to recognise exceptional individual contributions.

### Harassment and bullying prevention

There is zero tolerance of harassment or bullying of any kind. Employees are made aware of our Workplace Harassment and Bullying policy as part of their induction, and we highlight and reinforce behaviours that reflect the culture we are building.

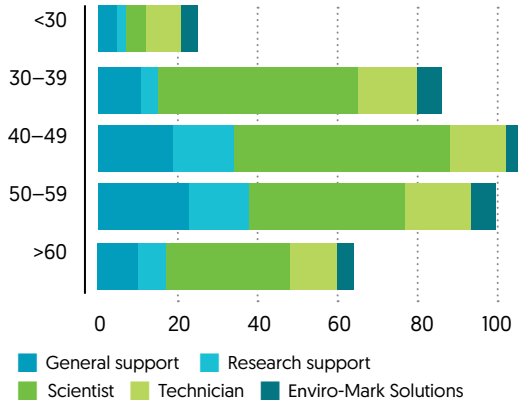
### Safe and healthy environment

Following 17 years of certification within the ACC Workplace Safety Management Practices (WSMP) scheme, the organisation is now undertaking external certification against the AS/NZS 4801 H&S standard. We are also investigating the Safety Differently model, which offers exciting potential for a people-centred, knowledge-based organisation such as Manaaki Whenua.

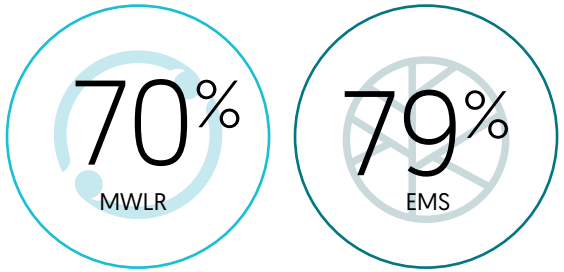
Health and safety training, equipment and supervision are given to all staff, ensuring they are safe in their roles, with performance appraisals and position descriptions clarifying individual responsibilities for health and safety.

We also focus on reducing work-related stress and enhancing individual lifestyle choices, with a number of organisational initiatives available to employees, including access to the online website Tracksuit-Inc.

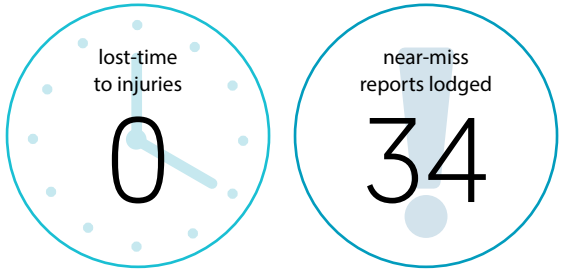
AGE BAND (YEARS)



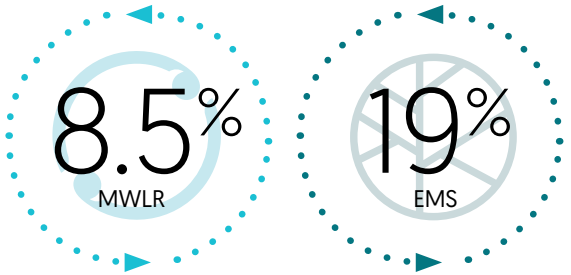

EMPLOYEE ENGAGEMENT




HEALTH AND SAFETY




EMPLOYEE TURNOVER



# Manaaki Whenua scientist is Zonta Science Award winner

A love of the natural world saw Manaaki Whenua scientist Dr Jessie Prebble named the 15th Biennial Zonta Science Award winner. The award was established in 1990 by the Zonta Club of Wellington to further the status of New Zealand women in science.

After a rigorous selection process, Dr Prebble, a plant systematist at Manaaki Whenua, was chosen from 33 applications by early career women scientists as this year's recipient. She was presented with the award by the Governor General, the Rt Hon. Dame Patsy Reddy, at a ceremony at Government House in June.

An outstanding role model for other young women pursuing a career in science, Jessie was selected for the award after demonstrating that through her work she contributes to her community.

Along with the accolade, Jessie received $18,000 to fund activities to further her career and research. She has chosen to use the award to visit three laboratories in the USA and to work with leading plant scientists at the University of Florida. There, she will learn a new technique of DNA sequencing that improves scientists' ability to discover and describe species, which she will share with other scientists in New Zealand.


*Plant systematist Dr Jessie Prebble takes images and collects plant samples at the Christchurch Botanic Gardens.*

# Our Partners

Foundation Goal

**Manaaki Whenua is working to develop strategic partnerships that increase our national impact, while enabling us to focus on our core business of research, science and technology.**

Strategic partnerships enable effective and efficient outcomes, such as product development (e.g. predator controls and land-use tools); policy support (e.g. land and water goals); returns from very innovative science (e.g. genomics, artificial intelligence); increased well-being from regional and Māori land development; and sustainable science capability (e.g. access to emergent and specialist skills).

As a Crown Research Institute we believe Manaaki Whenua has an important role to play in partnering with iwi entities to identify and help realise shared cultural and community aspirations for our land and environment. We work in close partnership with related entities, including Predator Free 2050, the New Zealand state-owned enterprise Orillion, and the new Strategic Science Investment Fund (SSIF) Genomics Platform. Aligning with these initiatives will greatly facilitate the delivery of national goals.

NEW ZEALAND'S BIOLOGICAL HERITAGE | Ngā Koiora Tuku Iho | National Science Challenges

## National Science Challenges

National Science Challenges take a collaborative approach to solving some of New Zealand's biggest issues. They are an opportunity to increase the stretch and impact of our research and to provide an economy of scale for working with collaborators. Manaaki Whenua is proud to host one of New Zealand's 11 National Science Challenges, New Zealand's Biological Heritage (NZBH). We also contribute to Our Land and Water, Deep South, Resilience to Nature's Challenges, Science for Technological Innovation, Building Better Buildings, Towns and Cities, Sustainable Seas, and to MBIE's Unlocking Curious Minds,

### BioHeritage Challenge, Ngā Koiora Tuku Iho

The BioHeritage Challenge has been underway for four years. During this time, it has delivered a portfolio of novel, participatory, and transdisciplinary science, built partnerships across a range of sectors and communities, interwoven a Māori world view throughout the Challenge, and sought to connect, accelerate, and transform the way we do science in New Zealand.

National Science Challenges are only as good as the capability and expertise in their Challenge Parties. This year, the BioHeritage Challenge brought the Cawthron Institute, a new Challenge Party, on board. There are now 18 Challenge Parties contributing expertise to reverse the decline of New Zealand's biological heritage. We have a special role as the host in supporting the BioHeritage Challenge, both through administrative support and aligned research activity.

The Challenge's objective is to protect and manage biodiversity, improve biosecurity, and enhance resilience to harmful organisms. The objective has very strong alignment with all four of our ambitions. Through a portfolio of direct and aligned research, the BioHeritage Challenge is now making tangible progress toward delivering science and innovation with greater impact and benefit to Aotearoa New Zealand. Manaaki Whenua plays a central role: we have aligned c. $8M of SSIF funding to the BioHeritage Challenge.

The collaborative way of working in the Science Challenges also calls for inter-disciplinary research skills, and capability to integrate across disciplinary boundaries to achieve common goals. Manaaki Whenua has invested strongly in 'integrators' this year to support Challenges and other collaborative initiatives.

A number of major science breakthroughs and technology discoveries have been achieved in the BioHeritage Challenge this year. We are proud to have supported the following:

—
Major conceptual progress in understanding changes in ecosystems that contribute to resilience and provide early indications of tipping points, with implications for predicting extinction sequences and suggesting trajectories for restoration. This multi-institute team published their findings in two top international journals.

—
One of the largest surveys ever undertaken on public attitudes to pest control technologies in Aotearoa (>8,000 respondents, including c. 1,000 Māori respondents) discovered four perspectives held on pest control in New Zealand society. We are now contributing social research expertise to the next phase of this exciting work.

—
Led by Tūhoe Tuawhenua, a Manaaki Whenua team documented and published the tribe's world view representation and applied the concept to a cultural keystone species for Tuawhenua, the kererū.

—
Our work, led by postdoctoral researcher Patrick Garvey, who discovered a super-lure for invasive stoats, was chosen by MBIE as the top highlight from the Challenge for this year, and featured in their own report highlighting progress across all the National Science Challenges.

—
We contributed to a collaboration highlighting the 'conservation paradox' for involvement of indigenous peoples in conservation.

—
Establishing national and international partnerships is another way the Challenge is driving a step-change in the way science is done in Aotearoa. Our work on DNA metabarcoding for environmental monitoring has been enhanced through a strategic collaboration with the BASE (Biomes of Australian Soil Environments) programme in Australia. This collaboration was facilitated by the BioHeritage Challenge.

### NZBH Challenge Parties

AgResearch, ESR, GNS Science, NIWA, Plant & Food Research, Scion, DOC, MPI, Auckland University of Technology, Lincoln University, Massey University, University of Auckland, University of Canterbury, University of Otago, University of Waikato, Victoria University of Wellington, and Manaaki Whenua as host.

# Our Infrastructure

Foundation Goal

**Our facilities and technology work is focused on creating fit-for-the-future buildings, workspaces, ICT and science equipment. This infrastructure underpins the efficiency and effectiveness of the organisation, and our ability to deliver on our core purpose.**

Our workspaces are evolving to reflect the changing needs of science and the expectations of a new generation of staff. Our buildings and facilities need to be fit for purpose and supported by smart systems and processes to deliver effective research and outcomes in the future, and to enable our people to carry out their work. Manaaki Whenua has an ongoing programme to upgrade buildings and research infrastructure at all our sites.

We continue to make significant investment in our IT infrastructure to protect our data, support and enable high-quality science, and improve the resilience of systems. We are working closely with other Crown Research Institutes to adapt best ideas and ensure IT systems are suitable, affordable over the long term, secure, and take into account the very rapid innovation occurring in this sector.

*Preliminary design render for the new building entrance at our Lincoln campus*

## Te Rauhītanga

This year we moved from the business-case phase and initiated our Lincoln redevelopment programme, known internally as Te Rauhītanga (the gathering place).

The programme originated with the need to replace the Godley building at our Lincoln campus, but it also presents us with an opportunity to develop and pioneer new ways of working in support of Strategy 22.

The vision of the programme is to pioneer new ways of working that power exceptional science, better integration, and a stronger, united culture. Our programme team is designing the new building and physical environment, exploring and implementing key technology to support future ways of working, and working with our people to develop the cultural and behavioural changes required to support our strategy.

The programme will see us open our new building in late 2020.

## Technology infrastructure

We have also begun a number of key technology changes:

—
further developing capabilities and infrastructure to enable exploitation of big data

—
enhancing technology to support productivity, effective project and information management

—
upgrading cyber security and IT system resilience

—
enhancing collaboration tools to enable better connectivity for devices and the ability to connect securely with external partners for easier collaboration – this is essential to enable greater staff mobility and utilisation of collaborative spaces expected in the new facilities.

## Our ways of working aspirations

### INSPIRATION

Stimulating creativity, sharing knowledge and ideas, motivated by kaitiakitanga. Working here, surrounded by each other, we are proud to positively impact our land and future.

### PRODUCTIVITY & WELL-BEING

Able to do our best work each day, working seamlessly to deliver great science for New Zealand. Feeling under control, optimistic, and valued for the work we do.

### COMMUNITY & INTEGRATION

Broadening horizons, searching out diversity of thought, and partnering with others within and beyond Manaaki Whenua to achieve our goals.

### FLEXIBILITY

Adapting to thrive in a changing world. Openness to experiment with new approaches, balancing certainty with opportunity, and accommodating the needs of others.

# Our Sustainability

Foundation Goal

**Our contribution to the future of New Zealand is underpinned by a sustainable business model that balances social, economic, and environmental impacts.**

While sustainable business is a core tenet of our culture and business, it is also critical to ensure our continued positive impact for New Zealand. Our long-term financial management is designed to optimise our funding performance over time, ensuring we can both deliver on immediate research needs, but also make longer-term investments in critical science and business infrastructure.

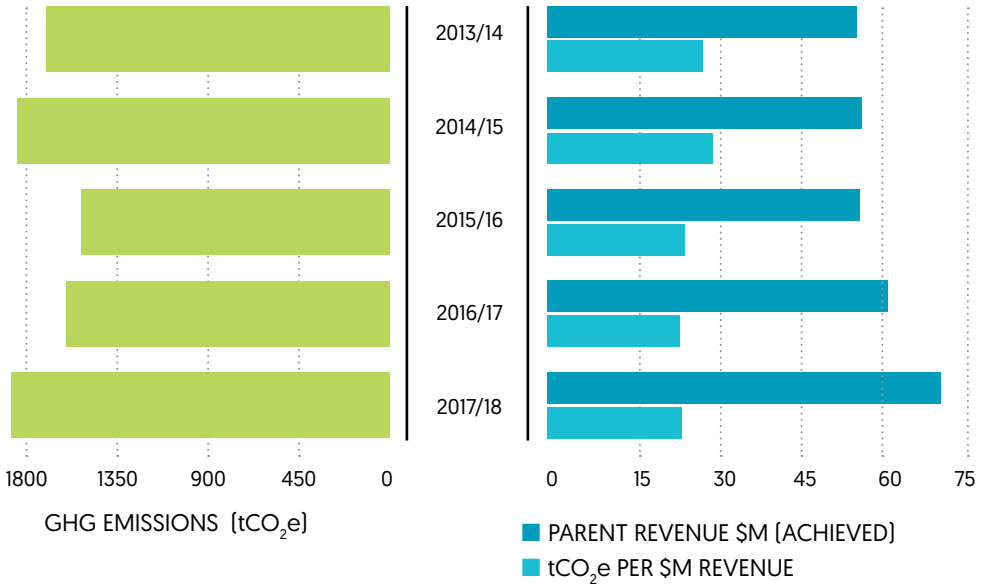
While our research is focussed on helping New Zealanders live more sustainably with our land, we are also end consumers of New Zealand's resources, and choose to lead the way in mitigating and measuring our own impact on the environment. As outlined in the section 'Our People', our ability to deliver our exceptional science, research, and real-world solutions depends entirely on our ability to attract and retain the best scientists, researchers, technicians, and support staff that New Zealand and the world have to offer.

carboNZero Cert TM

TELARC REGISTERED ™
Environment
ISO 14001

Podocarpus nivalis, *snow or mountain totara, near Lake Man, Doubtful Range.*

REVENUE & GREENHOUSE GAS EMISSIONS




### Sustainable development goals

Sustainability is our business. We work with a wide range of organisations to understand sustainable development goals and implement pathways to achieve them. That is our principal contribution: the social, economic and environmental impact of our research, science, and technology. In recent years our social focus has been on talent development, gender equity and staff welfare, including health and safety (see 'Our People' section). Our own operations have their own impacts, and we have focussed on carbon footprint and a range of other goals to improve our own environmental performance. We have been ISO14001 certified since 1998 and we have been carbon neutral since 2011. For the 7th year running Manaaki Whenua has maintained carboNZero certification through our subsidiary Enviro-Mark Solutions. As the CRI for our land environment, our commitment to carbon neutrality goes back even further, and through our greenhouse gas emissions management and reduction plan we are pleased to have exceeded our 15% emissions intensity reduction target.

Achieving carboNZero certification requires that we both measure and manage our greenhouse gas emissions (GHG) reduction, and then neutralise any remaining unavoidable emissions through cancellation of an appropriate number of verified carbon credits. We have offset our unavoidable carbon emissions by purchasing all our carbon credits from the Hinewai Reserve. The Hinewai Reserve, near our headquarters, is a biodiversity taonga on Banks Peninsula, developed and managed by botanist (and Manaaki Whenua research associate) Hugh Wilson. The 1,230 hectares of native bush and abundant bird life are a case study of the value of gorse as a nursery plant for naturally regenerating native forest. Hinewai was one of the first blocks to be admitted to Manaaki Whenua's Emissions Biodiversity Exchange (EBEX21) programme. It was the site where many of the protocols were developed for how private landowners could participate in 'carbon farming'.

### Economic sustainability

Our contribution to the future of New Zealand is underpinned by a sustainable business model that balances social, economic, and environmental impacts. While sustainability is a core tenet of our culture and business, it is also critical to ensure our continued positive impact for New Zealand. Our 5-year financial plan reflects a step change in activity during recent years resulting from the success in recent funding rounds, a lift in commercial revenue, and our leadership of the Bioheritage NSC. This is shown in the 53 new jobs created and filled in the last year.

Our long-term financial management is designed to optimise our funding performance over time, ensuring we can deliver on immediate research needs, and also make longer-term investments in critical science and business infrastructure.

SUMMARY TABLE OF GROUP FINANCIAL PERFORMANCE INDICATORS

| | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|
| | Achieved | Achieved | **Achieved** | Target |
| **Revenue, $M** | 57.2 | 65.0 | **77.7** | 86.7 |
| **EBIT, $M** | 2.8 | 4.8 | **6.3** | 2.1 |
| **NPAT, $M** | 2.2 | 3.7 | **4.9** | 2.0 |
| **Total assets, $M** | 53.6 | 62.6 | **68.7** | 67.1 |
| **Return on equity** | 6.7% | 10.4% | **12.4%** | 4.6% |

### Financial result

Total revenue for the year of $77.7 million was $12.7 million up on the previous year. This reflects a strong year, with demand for our science expertise increasing both through the MBIE Endeavour contestable research funding and non-MBIE funding from government and commercial clients. Net Profit after Tax at $4.9 million was $2.6 million better than budget and $1.3 million better than the previous year.

As a CRI we do not seek to maximise profit beyond what is needed for financial resilience, which is agreed in advance with our government owners. This year we invested significantly in new staff, and we are continuing to do that this year as an investment in our future impact. Our Balance Sheet and cash flows have the capacity to enable the significant planned investment phase that will contribute to making Manaaki Whenua a more sustainable and future-proofed organisation.

## Enviro-Mark Solutions

**Helping organisations take credible action for a better environment and a sustainable low carbon economy.**

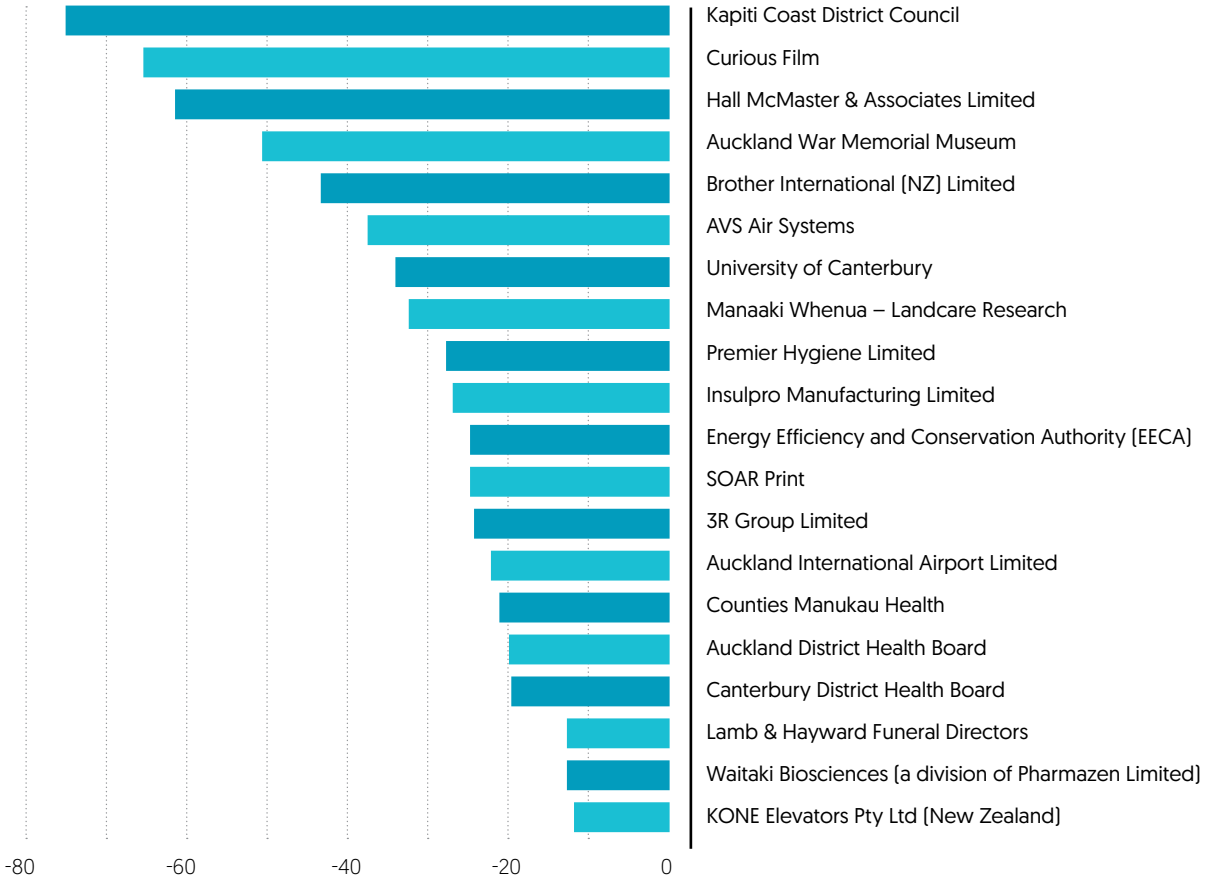
ENVIRO-MARK SOLUTIONS

The momentum for environmental stewardship and sustainability in New Zealand has grown substantially over the last few years, driven by the ratification of the Paris Agreement, Agenda 30: Sustainable Development Goals (SDGs) and the imminent Zero Carbon Bill. Our subsidiary, Enviro-Mark Solutions, is witnessing these changes first hand, and helping organisations improve their environmental performance, meet international best practice, and make credible claims to their stakeholders.

Enviro-Mark Solutions is the leading provider of environmental certifications in New Zealand. The carboNZero and CEMARS (Certified Emissions Measurement And Reduction Scheme) certification programmes help organisations measure, manage, and reduce their carbon emissions. The Enviro-Mark and Energy-Mark certification programmes help organisations develop robust management systems that manage their environmental impacts and energy consumption. In addition to the four certification programmes, Enviro-Mark Solutions offers support with product life-cycle assessment, setting Science-Based Targets, CDP reporting, emissions factor development, and materiality assessment against the Sustainable Development Goals (SDG) framework.

Enviro-Mark Solutions has seen an exponential increase in new programme sales for the second consecutive year (74% increase over 2017/18 and 64% over 2016/17) that reflects the growing interest in Enviro-Mark Solutions' products and services.

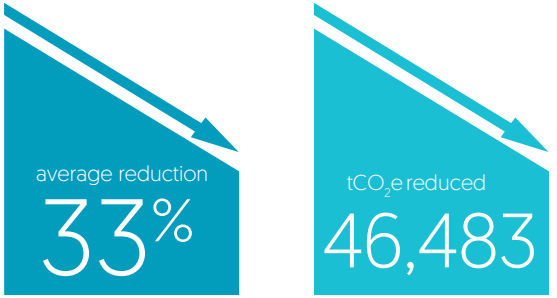
TOP CARBON REDUCTION BY CEMARS & CARBONZERO CERTIFIED ORGANISATIONS




% absolute reduction* of mandatory emissions since base year of certification ($tCO_2e$)

* All reductions certified as of April 2018

In June 2018, Enviro-Mark Solutions recognised organisations from the CEMARS and carboNZero programmes that had made the largest reductions in their carbon footprint, aiming to inspire other New Zealand organisations to take action. Together, these organisations reduced 46,483 tonnes of $CO_2$ equivalent emissions ($tCO_2e$), which is more than the average annual emissions from over 17,000 New Zealand households. Since 2006, Enviro-Mark Solutions has certified over 2,000 GHG inventories for companies from five countries, representing more than 182 million tonnes of GHG emissions – more than twice New Zealand's annual emissions.




Enviro-Mark Solutions has expanded to meet the demand for its services. It has recruited new staff across the company, building technical expertise to ensure that current and new clients continue to have access to expert support. Enviro-Mark Solutions experts are active members of the sustainability community and aim to inspire others by regularly participating in environmental challenges (such as the nation-wide Aotearoa Bike Challenge) and promoting local carbon credit projects (such as Hinewai Reserve).

'Walking the talk' is inherent to Enviro-Mark Solutions' DNA. Enviro-Mark Solutions has reduced its own carbon emissions by 52% over the past five years and maintains a robust environmental management system that is equivalent to Enviro-Mark Gold-level certification. Enviro-Mark Solutions has also submitted targets to the Science-Based Targets initiative, meeting international best practice and recognising that an ambitious target is required to contribute to the level of decarbonisation required to keep global temperature increase below 2°C.

Enviro-Mark Solutions is anticipating increasing legislative pressure for organisations to manage their carbon emissions in the coming years. With a wealth of experience both within New Zealand and internationally, Enviro-Mark Solutions is well placed to work closely with businesses across all sectors to improve their environmental performance and ultimately a better environment for all New Zealand.

# Innovative & Challenging

Science Goal

Manaaki Whenua has internationally recognised scientists and researchers who are working to understand our land, biodiversity and environment for the benefit of New Zealand. A key goal of our work is that our science is innovative in its approach to adding to global knowledge, and we do not shy away from the many challenging issues facing society.

Manaaki Whenua aspires to be in the top 15% of research organisations globally for citation impact of publications, maintaining and building on our internationally and domestically recognised excellent science. For our publications from 2017/18 we already have a category-normalised citation impact of 1.7 (this compares with 1.75 for the period 2015–2017, where we ranked second in New Zealand overall).

Out of our 11 major disciplines, based on citation impact (2015–2017), we have:

—
five within the top 25% of all research organisations globally, with two (mycology and evolutionary biology) within the top 2%

—
four ranking the highest within New Zealand (soil science, agriculture, mycology and evolutionary biology)

—
another three that rank within the top three research providers within New Zealand (entomology, zoology, and geosciences).

*University of Canterbury student Mehrnoush Tangestani implementing an algae experiment using LEDs at the Manaaki Whenua Lincoln site.*

## Major science publications

### Our Biodiversity

—

**Novel analyses of spatial distribution of endemism.** We published two articles on the first application of a 'big data' approach to analysis of the spatial distribution of biodiversity and endemism in New Zealand. A recently developed software tool, Biodiverse, was used to analyse over 200,000 georeferenced records from the New Zealand Virtual Herbarium, along with a novel DNA phylogeny, including all the vascular plant genera indigenous to New Zealand. The findings will have ramifications for land and conservation management as well as for understanding New Zealand biogeography.

—

**Ancient DNA (aDNA) used to illuminate previously unknown co-existence relationships.** We used aDNA metabarcoding on moa and kākāpō coprolites to show cryptic aspects of dietary behaviour and the distribution and co-extinction of parasites. The paper presents the first evidence that moa and prehistoric kākāpō consumed ectomycorrhizal fungi, suggesting these birds played a role in dispersing fungi key to New Zealand's natural forest ecosystems.

### Our Biosecurity

—

**Collecting the evidence base for biological control of the African tulip tree.** This is one of the world's most invasive trees and this manuscript detailed the origins of weed populations and where candidate biocontrol agents may be found. African tulip tree is a key target in the Cook Islands biocontrol project, with the first biocontrol agent released against it there earlier this year. Plans are also being made to release biocontrol agents for this invasive tree in Vanuatu.

—

**Letter to *Science* on need for broader conservation approach.** We published a letter to *Science* arguing that the current focus on a species-based conservation approach is inadequate to conserve the 'hidden' biodiversity and protect from unforeseen circumstances. Thus, it is important to switch to a broader approach to conservation that aims to maximise benefits across entire communities and the processes posing most threat.

—

**Web of Science has denoted one of our co-publications as a 'hot paper'.** These are papers published in the past two years that received enough citations in March/April 2017 to place them in the top 0.1% of papers in their fields. In this paper, the authors recommended that countries adopt an integrated approach that focuses simultaneously on species that invade, sites that invade, and frequent pathways of invasion as focal points where maximum efficiencies can be made in combating invasive species and their adverse effects.

### Our Land

—

**Contribution to online pedometrics material.** We authored three chapters in Pedometrics: A System of *Quantitative Soil Information,* a reference book that provides comprehensive cover of all that pedometrics entails. The book has already had 2,450 downloads. The relevant chapters are entitled 'Soil material classes', 'Soil profile classes', and 'Digital mapping of soil classes and continuous soil properties'.

—

**Keeping the honey sweet.** To help understand and manage floral resources for bees, we published a paper (in *Ecological Applications*) that presents a spatial model for mapping monthly nectar and pollen production from maps of land cover. This model framework can contribute both to management decisions such as the best placement of apiaries, and to planning areas for bee protection or the planting of riparian vegetation.

### Our Environment

—

**Implementing the Sustainable Development Goals.** With colleagues from Australia, Brazil, Sweden, Germany, the Netherlands, and the US, we published a paper on implementing the Sustainable Development Goals. Key governance challenges identified are: cultivating collective action, making difficult trade-offs, and developing mechanisms for accountability.

—

**Onset of the warming Anthropocene formally identified.** We contributed to a global study published in *Nature Scientific Reports* that formally defined the onset of the Anthropocene in the geological timescale. Detailed analysis of radioactive elements in the annual growth rings of a Sitka spruce tree on Campbell Island provided the necessary evidence from the southern hemisphere.

---

"Five of our science disciplines are in the top 25% of all research organisations globally, two (mycology & evolutionary biology) are within the top 2%"

Citation impact (2015–2017)

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# Valued & Trusted

## Science Goal

Excellent research is in itself not enough to address New Zealand's environmental challenges. A growing focus for Manaaki Whenua is to deliver user-ready solutions and advice that respond to the needs of our users who must respond to those challenges, often with some urgency. A priority goal is that the solutions and advice we develop are valued and trusted because they meet users' priorities and expectations.

To achieve this, we continue to work closely with our major central and local government stakeholders to develop the evidence base for conservation, biosecurity, and land management policy, legislation, and regulation. Increasingly, we have employed deeper partnership approaches, such as secondments, to better understand the specific needs and priorities of those who will be using our advice and tools.

A recent example is our support for national State of Environment reporting: the national Land Domain report, *Our Land*, was released on 19 April by Statistics NZ and MfE. This is a statistical product, like GDP, Manaaki Whenua led the provision of scientific data and analysis for the report, with a senior staff member seconded to MfE, and other staff providing independent commentary on the report's findings. Our input ensured the report benefited from independent, science-led identification of the critical issues (e.g. soils, erosion, ecosystem services, biodiversity), as well as key science gaps. The report is being used to inform major policy reforms to support sustainable land management (e.g. The ministerial announcement of a new national policy statement on versatile soils).

*Science team leader Dr Peter Buchanan speaks to a student from Lake Brunner School during the 32nd Fungal Foray held at Lake Brunner, West Coast.*

An increasing number of our staff also provide science input to ministerial advisory groups, technical advisory groups and governance bodies to ensure expert advice informs decision-making. In addition, our senior staff regularly provide authoritative expert opinion. Examples this year include the provision of expert advice to the Environment Court on the Mackenzie Basin; guidance to the Minister of Conservation on wilding pines; and expert witness advice in MPI's successful prosecution of a person importing invasive species without the required permissions.

We act as the lead science provider to relevant high-priority initiatives that align with major national initiatives. For example, Manaaki Whenua led the development of the Predator Free 2050 Research Strategy. We also provide science support for a growing number of local predator-free initiatives, including: research provision to the large-scale Taranaki Mounga Taranaki Taku Tūranga programme, developing pest control options on Banks Peninsula, and outreach to conservation groups to share knowledge on optimising pest monitoring and control techniques.

Manaaki Whenua is custodian for almost a third of New Zealand's Nationally Significant Databases and Collections. These include biological resources (e.g. reference species collections), cultural knowledge, and soil and land resources. They are important scientific, cultural, and historical public good assets. These collections provide base knowledge critical to improving the conservation of New Zealand's land-based biodiversity, including species of importance to Māori. They also provide important reference collections for identifying biosecurity risks. We have made significant progress in digitising (and putting online) science information, images and other valuable information from our collections. This information is easily accessed and is being used in conservation, biosecurity, land management, and environmental sustainability in New Zealand.

## NATIONALLY SIGNIFICANT DATABASES

**Ngā Tipu Whakaoranga Database**
http://maoriplantuse.landcareresearch.co.nz

| | |
|---|---|
| 84,597 | Page views^ |
| 2,408 | Database records |
| 15 | Requests – cultural plant information (not flax) |
| 24,976 | Visitors |

**National Vegetation Survey (NVS) databank**
http://nvs.landcareresearch.co.nz

| | |
|---|---|
| 22,533 | Page views^ |
| 107,872 | Plots |
| 4,875 | Datasets supplied |
| 49 | Data requests |
| 431 | Registered users |
| 25 | New electronic datasets |
| 848 | Plots added |

**Land Resource Information Systems (LRIS)**
http://lris.scinfo.org.nz

| | |
|---|---|
| 118,780 | Page views^ |
| 5,554 | Data downloads |
| 7,323 | Users |
| 31,319 | Visits^ |

* in scientific publications (based on Google Scholar)
^ courtesy of Google Analytics

## NATIONALLY SIGNIFICANT COLLECTIONS

**New Zealand Flax Collection**
ww.landcareresearch.co.nz/harakeke

| | |
|---|---|
| 281 | Selections |
| 19 | Orders sent |
| 85 | Enquiries |
| 71 | Visitors |

**Allan Herbarium (CHR)**
www.landcareresearch.co.nz/allanherbarium

| | |
|---|---|
| c. 650,000 | Specimens |
| 1,016 | Specimens sent |
| 45 | Loan requests responded |
| 670 | Identification & enquiries |
| 428 | Visitors |

**New Zealand Arthropod Collection (NZAC)**
www.landcareresearch.co.nz/nzac

| | |
|---|---|
| c. 7 million | Specimens |
| 52 | Loan requests responded |
| 360 | Identification & enquiries |
| 68 | Visitors |

**New Zealand Fungarium (PDD)**
www.landcareresearch.co.nz/pdd

| | |
|---|---|
| 101,137 | Specimens |
| 590 | Specimens sent |
| 22 | Loan requests responded |
| 159 | Identification & enquiries |
| 167 | Visitors |
| 34 | Specimens cited* |

**International Collection of Microorganisms from Plants (ICMP)**
www.landcareresearch.co.nz/icmp

| | |
|---|---|
| 21,395 | Cultures |
| 94 | Orders sent |
| 611 | Cultures sent |
| 160 | Identification & enquiries |
| 167 | Visitors |
| 162 | Specimens cited* |

# Strategic & Integrated

Science Goal

Our partners' challenges, such as freshwater quality and climate change impacts, combine many issues – social, economic and environmental. It is therefore essential that our science is strategic (big picture) and integrated across disciplines, cultures, and actors. We co-innovate with partners to ensure we address the right level of complexity within our science programmes.

Integration is necessary between knowledge sources, with Māori, across disciplines, and with stakeholders and end users. However, integration also requires innovation and research designed from the beginning for implementation. We are therefore following an 'i3' model – Integration, Innovation and Implementation.

Manaaki Whenua began an internal programme to support the building of greater capacity and capability in undertaking i3 research. Key achievements for the programme were:

—
surveys and interviews to stocktake and plan for more i3 research – these data inform the development of supporting resources

—
initiation of the curation of a toolkit of methods and approaches to further integrating researchers

—
the start of a series of workshops to raise awareness and capability in using the toolkit and build a community of practice

—
within the Deep South National Science Challenge, we led a study of 'Climate Resilient Māori Land' within the Waiapu catchment. This collaborative project with He Oranga mō ngā Uri Tuku Iho Trust, Scion, and the University

incorporated potential climate change impacts into land investment decisions and provided holistic approaches for managing this climate-sensitive catchment. Using a probabilistic cost–benefit analysis, relevant to policymakers, the paper identified that the benefits necessary to cover erosion-reduction investments using native trees for afforestation would need to be higher than expected to hedge against climatic uncertainty. However, the increased benefits of this approach to kaitiakitanga, manaakitanga, and Whakatipu Rawa were significant.

## Science New Zealand National Awards

In November 2017 Science New Zealand, which represents the seven Crown Research Insitutes (CRIs), hosted its inaugural national awards at Parliament.

The awards were part of a week of celebration for Science New Zealand and the CRIs, marking the 25-year anniversary of CRIs with a conference, public lectures, and displays at Te Papa, and the awards evening.

Manaaki Whenua was pleased to see our people recognised at the event for their contributions.

### Early Career Researcher Award – Nicholas Cradock-Henry

In his six years at Manaaki Whenua, Nick has become a senior researcher in Social Science. He is well recognised, and was one of 20 global scholars invited to join the UN University of Aspiring Leaders programme. He also won the only Marsden in the organisation in 2016.

### Lifetime Achievement Award – John Innes

John has been a key part of pioneering the use of time-lapse video monitoring to identify the cause of decline in New Zealand birds, which has lead to numerous ground-breaking discoveries in pest and predator control. Among these discoveries is kōkako recovery, where breeding pair numbers have grown dramatically. This remains one of New Zealand's most successful conservation stories. John has also been at the forefront of research on the risks to, and ecological benefits of, large-scale, pest-fenced sanctuaries since their inception.

### Team Award – TBfree Team

Tuberculosis (TB) is an ancient disease of humans and livestock, with the bovine form – introduced by early settlers – creating major human health and agricultural problems. This team's research achievements have transformed 'TB-in-wildlife' from an out-of-control and rapidly worsening situation in the early 1990s, to today's situation where TB eradication is a realistic goal for New Zealand.

# Engaged with all New Zealanders

Science Goal

**With Strategy 22, Manaaki Whenua has committed to an increased focus on engaging all New Zealanders in our science.**

As one of New Zealand's seven CRIs, we have a responsibility to provide objective, scientific information on our land environment to the New Zealand public. It is becoming increasingly clear that making progress on the land and environmental challenges we face will take the collective effort of all New Zealanders, including government, industry, Māori, and other landowners, scientists, communities, and individuals.

"Progress on the difficult issues we face is more likely if scientists help lead public engagement and shape public understanding"

[Megan Woods, Minister of Research, Science and Innovation].

Our goal to engage with all New Zealanders challenges us to push our external engagement wider than ever before. Our aspiration is to become a household name, so that all New Zealanders will have easy access to information that can help them understand our biodiversity, biosecurity, land, and environment. This strategic goal will require the combination of modern communication and engagement strategies, and more collaborative and integrated approaches to science.

*Kohae Cherrington, 10 yrs, from Kura Kaupapa Maōri o Manawatū, investigates some captured moths during the Ahi Pepe camp held in Whanganui.*

### Sharing our stories

Sharing our stories  is about creating an awareness of Manaaki Whenua that can be developed into deep engagement. While there is no lack of great stories within Manaaki Whenua, engaging New Zealanders with these stories hinges on our ability to create and share compelling content. There are two parts to this: 1) developing rich, engaging multimedia story content, and 2) delivering this content across a wide range of relevant channels.

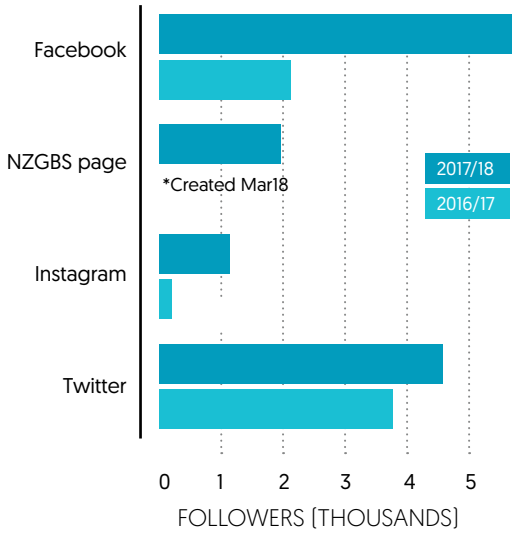
Our new in-house content team is tasked with travelling around New Zealand to uncover, capture, and bring to life our stories through rich video, beautiful photography, and informative, approachable science writing. This content can then be packaged for delivery to our audiences through several channels.

News media teams are extremely resource-constrained today. However, our content team is able to create news-ready 'content release' story packages that greatly increase our probability of news coverage. Our proactive biocontrol story on the successful release of the Japanese honeysuckle biocontrol agent, the Honshu butterfly, is a great example. Our video content was picked up and used across several TV news shows including TV1 News at 6 and The Project. We are also able to provide timely 'reactive' news-ready content, such as a recent content package in support of the media interest in the rabbit biocontrol virus RHDV1-K5 release. In June we had an audience reach of more than three million.

### The reach of digital

Digital technologies and communications channels provide us with the potential to reach all New Zealanders. In the past financial year our digital strategy has focussed on growing our social media audiences through the active management of these communities, and through the delivery of regular engaging content supplied by our new content team. Social media platforms provide us with a way of taking our stories to our audiences, rather than posting stories on our website and expecting them to come to us.

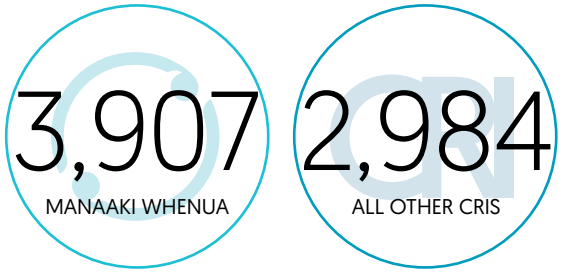
SOCIAL MEDIA ENGAGEMENT




This focus has already seen significant gains both in our regular audience (followers), and in our ability to reach a broader audience (engagements) with key relevant content. On Facebook we have seen growth in our followers from 2,118 at the end of FY17 to 5,686 and counting.[1] In the last quarter, our Facebook engagements were greater than the engagement numbers for all other CRIs combined.[3]

Instagram, a channel we have only recently started developing with our new photography content, grew from 200 followers in March 2018 to 1,150 followers in the space of 3 months.

FACEBOOK ENGAGEMENTS FOR JUNE 18




Our most popular Facebook post for the 2017/18 year was one inviting the public to vote for their favourite New Zealand fungus, with a poll being created in collaboration with Manaaki Whenua mycologists and hosted on our website. This post reached 54,524 people[1], and was shared 285 times, with 2,476 people voting.[2]

A new Facebook page was set up this year to support the NZ Garden Bird Survey (NZGBS), and a successful campaign resulted in 2,500 likes over just two months, with NZGBS-related posts reaching some 367,000 people.[3]

### Engaging New Zealanders in person

Public events present us with a unique opportunity to have much more in-depth conversations with the New Zealand public, as well as the partners with whom we work more regularly. This year we have taken the opportunity to bring our stories to life, and make our scientists accessible to the general public at a number of events.

[1] Facebook Insights
[2] Woobox social promotion application
[3] Sprout Social social media management tool

In partnership with the National Wetlands Trust, we ran New Zealand's first wetlands BioBlitz at Rotopiko in Hamilton. This was an opportunity for a number of schools and the general public to engage directly with our scientists in a two-day challenge to identify as many species as possible at Lake Rotopiko. During the event, students and scientists discovered two species of bacteria not previously known to science.

Together with the other six CRIs, we hosted the Science New Zealand conference at Te Papa in November 2017. This event represented the first real outing for our new brand and a great opportunity to engage the science community and the general public with our work. Te Papa visitors could see a biocontrol agent in action, and fly a drone while learning about the applications for these new technologies in science. Manaaki Whenua scientists were able to answer the questions of visitors and deliver a number of public lectures on key areas of research.

In June we attended Fieldays in collaboration with AgResearch. By sharing a stand, we were able to tell the story of 'Science Powering the Future of Farming' at this iconic event at Mystery Creek. This was the first time we had attended this event with a full stand in a long time, and our scientists were delighted by the opportunity to connect with industry, partners, and the farming public in particular.

### Citizen science

Our citizen science initiatives are perhaps the ultimate form of public engagement. These projects give New Zealanders the opportunity to participate actively in our science, through data collection, analysis, and the application of science solutions at local community scales.

Students and teachers from at least nine kura kaupapa (Māori immersion schools) across New Zealand gathered at Pūtiki Marae in Whanganui for Ahi-Pepe | MothNet's first North Island camp. The students, from schools from Invercargill to Hamilton, spent five days with project leader Dr Barbara Anderson and the wider team, learning about the importance of moths in New Zealand and how to run their own Ahi-Pepe experiment back at their school.

This event marked the release of the North Island Ahi-Pepe | MothNet identification guides to New Zealand Macro Moths, building on last year's launch of the South Island moth guides.

Working with the public to achieve large-scale data collection is an aspiration shared by many citizen science programmes. The New Zealand Garden Bird Survey (NZGBS) programme is a great example. Building on previous years, this year's survey saw 5,300 responses -- a record number. This was supported through the growth of the NZGBS Facebook community, and great interest from the media due to the release of the *State of New Zealand Garden Birds* report.

New Zealand GARDEN BIRD SURVEY


*Manaaki Whenua's stand at the 2018 Fieldays at Mystery Creek, Hamilton.*

# Ancestral knowledge in the classroom

**Manaaki Whenua researchers have launched a bilingual teacher guide and a student booklet in te reo aimed at teaching Māori students ancestral knowledge about fungi (hekaheka).**

The book, *Ngā Hekaheka o Aotearoa*, was launched in December last year at Auckland's Te Kura Kaupapa Māori o Ngā Maungarongo. It combines Manaaki Whenua research with Māori knowledge and uses of fungi, which played an important role in food, medicine, fire-carrying, and tattooing for early Māori.

Lead researcher and co-author Dr Peter Buchanan initiated the project in the hope of making this indigenous scientific knowledge more accessible to Māori students.

Around 7,000 to 8,000 species of fungi have already been formally identified and named in New Zealand, but researchers expect there are thousands more. Many Māori names of fungi can no longer be matched to their relevant fungal species.

Educationalist Dr Georgina Stewart from AUT and translator Hēni Jacob co-authored the resource.

One hundred and eight kura kaupapa throughout New Zealand have received a class set of the student booklets and a teacher guide. The project was funded by MBIE's Curious Minds programme.


*Dr Peter Buchanan holding* Ngā Hekaheka o Aotearoa, *a booklet he co-wrote on traditional Māori uses of fungi, launched at a kura kaupapa in Auckland.*

# Glossary

| | |
|---|---|
| ACC | Accident Compensation Corporation |
| aDNA | Ancient DNA |
| CEMARS | Certified Emissions Measurement and Reduction Scheme |
| CPI | Consumer Price Index |
| CRI | Crown Research Institute |
| DOC | Department of Conservation |
| eDNA | Environmental DNA |
| EPA | Environmental Protection Agency |
| FDD | New Zealand Fungarium |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas |
| ICMP | International Collection of Microorganisms for Plants |
| ICT | Information and Computer Technology |
| MBIE | Ministry of Business, Innovation and Employment |
| MfE | Ministry for the Environment |
| MPI | Ministry for Primary Industries |
| NASA | National Aeronautics and Space Administration (US) |
| NSC | National Science Challenge |
| NZBH | New Zealand's Biological Heritage |
| NZGBS | New Zealand Garden Bird Survey |
| OGC | Open Geospatial Consortium |
| PKW | Parininihi ki Waitōtara |
| SCP | Statement of Core Purpose |
| SOC | Soil Organic Carbon |
| SSIF | Strategic Science Investment Fund |
| NIWA | The National Institute of Water and Atmospheric Research |
| TB | Tuberculosis |
| SDGs | United Nations Sustainable Development Goals |
| VMO | Values Monitoring and Outcomes |
| FAO | Food and Agriculture Organisation of the United Nations |

*A native New Zealand weevil on a blade of grass.*

# Directory

**DIRECTORS**

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Dr Paul Reynolds QSO (Deputy Chair)
Dr Chris Downs*
Prof Caroline Saunders
Prof Emily Parker
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| | |
|---|---|
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| Katrina Benedetti* | General Manager, People & Culture |
| Kylie Hansen^ | General Manager, People & Culture |
| Dr Steve Lorimer | General Manager, Development |
| Holden Hohaia | General Manager, Māori Development |
| Dr Peter Millard | General Manager, Science |
| Nigel Thomson | General Manager, Corporate Services |
| Dr Fiona Carswell | Chief Scientist |
| Chris McDermott | General Manager, Brand & Communications |

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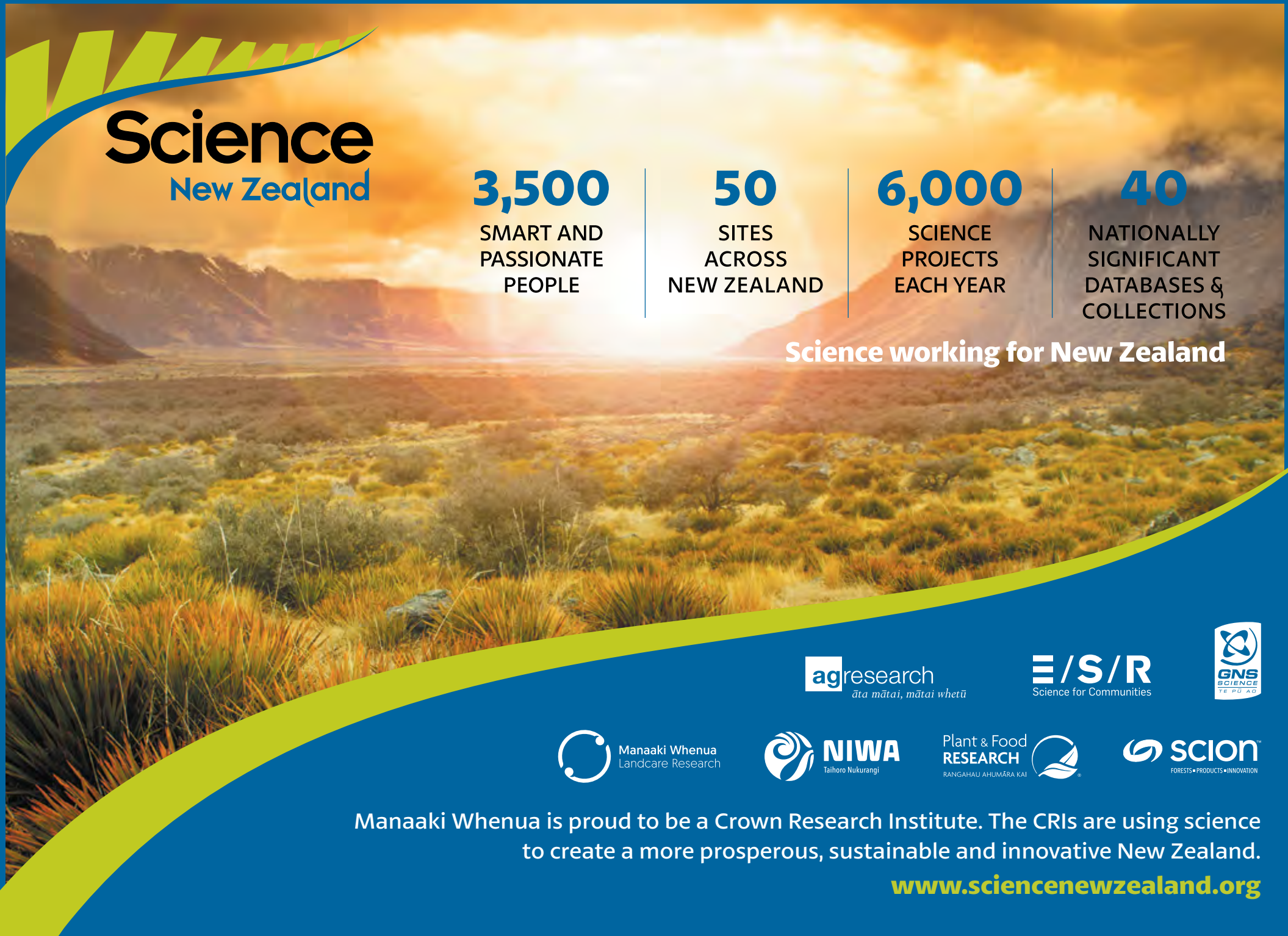
* To June 2018
^ From July 2018


Science
New Zealand
3,500
SMART AND PASSIONATE PEOPLE
50
SITES ACROSS NEW ZEALAND
6,000
SCIENCE PROJECTS EACH YEAR
40
NATIONALLY SIGNIFICANT DATABASES & COLLECTIONS
Science working for New Zealand
agresearch
āta mātai, mātai whetū
E/S/R
Science for Communities
GNS SCIENCE
TE PŪ AO
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Landcare Research
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